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ABSTRACT

This study was conducted to investigate five research questions concerning computer teachers: (1) How do male and female computer teachers compare in terms of professional preparation and experience? (2) What are the demographics of computer teachers currently in the classroom? (3) How do computer teachers' perceive their male and female students? (4) What levels of proficiency and expertise currently exist in the classroom among computer teachers? and (5) What are the attitudes of computer teachers in the field? Teachers were sampled from every unified school district in Orange County, California. A questionnaire was administered with items pertaining to educational and professional backgrounds, knowledge of topics within the field of educational technology, expertise in the field of educational technology, and attitudes towards current occupations. Some of the results were: male and female teachers do not differ significantly on most measures of background and experience; backgrounds are varied; demographic data suggest that males and ethnic minorities tend to be underrepresented; males and females are perceived as having similar levels of interest and ability in using the computer; computer teachers have considerable knowledge of current developments in the field of educational technology, have high levels of job satisfaction, and exhibit positive attitudes towards the teaching of computer use. (LL)

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Computer Teachers: A study of Background Characteristics, Preparation in Educational Technology, and Attitudes

by

Russell Okinaka

A Dissertation submitted to the Faculty of the
Claremont Graduate School in Partial Fulfillment
of the requirements for the degree of Doctor of Philosophy
in the Graduate Faculty of Education

Claremont, California

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Abstract of the Dissertation

Computer Teachers: A Study of Background Characteristics, Preparation in Educational Technology, and Attitudes.

by

Russell Okinaka
The Claremont Graduate School: 1991

The intent of this study was to answer five major research questions dealing with computer teachers. These questions were: 1) How do male and female computer teachers compare in terms of professional preparation and experience; 2) What are the demographics of computer teachers currently in the classroom; 3) How do computer teachers perceive their male and female students; 4) What levels of proficiency and expertise currently exist in the classroom among computer teachers; and 5) What are the attitudes of computer teachers in the field?

Teachers were sampled from every unified school district in Orange County, California. Subjects were provided with a questionnaire with items pertaining to educational and professional backgrounds, knowledge of topics within the field of educational technology, expertise in the field of educational technology, and attitudes towards their current occupations. Descriptive statistics were compiled on each item. The inferential techniques of Chi Square and t-test were also used on appropriate data.

Results of this study showed that male and female teachers did not differ significantly on most measures of background and experience. Generally speaking, backgrounds of the teachers sampled (both male and female) were quite varied--from those with little or no professional training, to those with advanced degrees in computer use. Demographic data showed that males tended to be under-represented as they are in other subject areas. Ethnic minorities were also under-represented. Computer teachers tended to perceive their male and female students as having similar levels of interest and ability in using the computer. Statistics showed that computer teachers had considerable knowledge

of current developments in the field of educational technology, but that there were areas where improvement might be recommended. Finally, the data showed that the teachers in this study had high levels of job satisfaction and positive attitudes towards the teaching of computer use.

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Chapter 1. Introduction

It was the purpose of this study to obtain information on the existing state of educational technology in the classroom. Specifically, the intent was to obtain answers to five major research questions:

1) How do male and female computer teachers compare in terms of professional preparation and experience?
2) What are the demographics of computer teachers currently in the classroom?
3) How do computer teachers perceive their male and female students?
4) What levels of awareness and expertise currently exist in the classroom among computer teachers?
5) What are the attitudes of computer teachers in the field? Specifically, how do computer teachers perceive their jobs? What are their current satisfaction levels with their present positions? Would they prefer to teach other classes besides computers? Were they forced into the positions they currently occupy?

Statement of the Problem

Studies have shown that males tend to dominate mathematically oriented professions, including those in the computer field. The literature also has indicated that males have tended to have greater degrees of proficiency in terms of computer use. The question of whether these trends manifest themselves in primary and secondary computer classrooms is important, as over-representation in terms of gender may have negative ramifications. Ethnic data is also important. Ethnic diversity has been a major issue in education for a long time. The issue of adequate minority representation has been the focus of many research articles.

The abilities that male and female students have with regard to computer use is also of great importance. It has been suggested that the United States is moving towards greater information orientation. Therefore, both males and females will require skills in using the computer. In this study, teachers have been asked about their perceptions of male and female computer use.

As computer teachers serve as resident technology experts at their respective school sites, it would help if they had high levels of awareness and expertise within the different areas of educational computer technology (particularly, those fields which are expanding rapidly and are currently under study). Any shortcomings in this area means that teachers at these school sites will have more difficult access to these innovations overall. Because the field has been constantly changing, and rapidly expanding, keeping up with the latest developments is difficult, and requires the expenditure of considerable effort. Nevertheless, these must be the requirements of a job with such great importance.

Finally, the attitudes of computer teachers in the classroom is of significance. Because the mandating of computer literacy in the classroom (and for teachers) has been relatively recent, there has been the possibility that certain teachers with lower "seniority" may have been "forced" into these positions. Satisfaction levels with these occupations may therefore, have suffered as a result. This study has attempted to determine if this has, in fact, been the case. Job satisfaction may have a direct influence over the quality of work turned out by an individual. Since the lives of students are affected by the training they receive, it is important to maintain the quality of that training at the highest possible levels.

Methods and Parameters

Teachers in every unified school district in Orange County, California were surveyed with a questionnaire that had items pertaining to the research questions mentioned above. A total of 301 questionnaires were sent out, and a total of 160 (N=160) responses were obtained. This represented a fifty-three percent (53%) response rate.

Orange County was selected in particular, because it was an area that has actively attempted to incorporate computer technology in education. Numerous school districts have devoted funds to supply classrooms with computers, software, and other peripheral devices. There have also been model classroom computer labs that have been established by major computer manufacturers to display the different types of technology that are currently available, or are being developed. This has provided an ideal setting for studying computer teachers in the field.

It should be mentioned that the measures used in this sample are, in some cases, opinions that may not indicate actual levels of awareness or expertise, but rather a point of view. Interpretations of the responses are detailed and analyzed in later chapters, and several points will be clarified in these sections.

Questionnaires were distributed by mail to computer teachers in every school in every unified district in Orange County. A cover letter was provided explaining the nature of the study. A self addressed stamped envelope was also included for returning the questionnaire. Three weeks after the initial questionnaire was mailed, a reminder was sent to those teacher who had not yet responded. A second reminder was sent three weeks after the first reminder.

The returned questionnaires were coded, and the numbers were then entered into a data file using the statistical package SPSSX. Descriptive statistics were compiled. Further, the inferential technique of Chi-Square analysis was used to compare males and females on nominal level measures. The inferential technique of t-test was used to compare males and females on interval level measures.

Importance of this Study

Computers have been used in education with increasing frequency since the advent of the microcomputer generation in the late 1970's (Lockard, Abrams, 1987). Many states have mandated the implementation of computer curriculums in both primary and secondary education (Turner, 1990). The key to these programs is that they have staff that are competent and knowledgeable in the fields that they represent. Further, the breakdown of teachers by gender and ethnicity should not overemphasize specific groups. Research in this field, however, indicates that males are over-represented when compared to their female counterparts. Studies have shown that males also tend to have more positive attitudes towards using the computer, and are more likely to pursue further course-work in the field.

The fact that males tend to dominate this area is attributed to different causes. First, computers have been associated with mathematics and mathematical ability--an idea which dates back to the original uses of electronic computers in the 1940's and 1950's (Bitter, 1984). There is a large body of research which supports the idea that males tend to outperform females in the field of mathematics. Many of these studies suggest that socialization is largely responsible for these observations. The specific reasons for these differences in mathematical reasoning abilities are beyond the scope of this study. It is an observation, however, that has ramifications into fields that have ties with mathematics. In Alexander Astin's 20 year study of American freshmen: 1965-85 (1987), descriptive statistics reveal that males tend to select mathematically oriented majors with much greater frequency than females. This difference holds up in fields requiring the use of the computer.

The importance of this is that computing is a field which is viewed socially (at least within this culture) as traditionally male oriented. Research indicates that computer companies appearing in periodicals--without exception, gear their advertisements towards white males. Women and minorities are severely under-represented, especially in user and systems magazines. These types of bias tend to perpetuate and perhaps aggravate the gap that already exists.

The problem is that computers are devices in which both males and females alike should have proficiency. The society of the United States that exists today is information oriented and is becoming more so. To be productive members of such a society, all members must have a knowledge of the tool that controls this information. If one group receives preferred amounts of exposure to this field, it will be the one that is most likely to thrive within information oriented environments.

A point of interest in this area is tied to who the teachers are in this field. Are males more likely to be computer instructors than females? Is this reflected in the current demographics of the public school system? Are teachers equally qualified to teach in this field? Have meaningful standards been established to insure such equality? The answers to these questions were a focus of this study.

It must also be realized that the potential to revolutionize education currently exists with the advent of superior technology. Many studies have been conducted in the field of Computer Assisted Instruction. The results have almost universally revealed that the computer is an effective tool that can truly help to improve the quality of education. It must be realized that the field of educational technology is constantly expanding. There are uses for computer technology that go well beyond the initial uses of programming that occurred in the early years of this field. Developments have occurred in areas of Computer Assisted Instruction, interactive video, computer managed instruction, Intelligent Computer Assisted Instruction (ICAI), expert systems, etc. The problem is that although research in these fields is occurring, the knowledge that teachers have of this research is uncertain. The overall awareness and expertise of computer teachers (who are the computer "experts" in the public school system) in these varied topic areas may not be very high. If this is indeed the case, then propagation of such software and technology developments will be hindered considerably. Only with increased awareness can the implementation of such developments become widespread.

It would behoove both content area teachers and administrators alike, to have current knowledge of the successes that have occurred using advanced educational technology. Students have become the benefactors of more individualized levels of instruction, improved classroom presentations within topic areas, increased rates of learning, and higher rates of information retention over time. Computers have also helped to reduce drop-out rates among "high risk" students; they have helped to mainstream students with learning disabilities; they have been shown to promote critical thinking skills in young children; and they are known to improve general motivational levels and attitudes throughout all grades. The educational problems that computers are capable of alleviating are diversified. It can be stated that computers computers do an effective job of helping to address the specialized student needs. If teachers and administrators are aware of these capabilities, there may be a greater demand for technology implementation within different school districts. The possibility for enhancing the quality of instruction, particularly in this age of accountability, is one that should be strongly considered.

Hypotheses

With regard to the research questions posed, the following hypotheses were suggested:

A) It is anticipated that males will have greater levels of professional preparation and experience.

B) Males will predominate as computer teachers in the classroom. Females will be under-represented.

C) Teachers will perceive their male students as being more interested in computer use. Teachers will also perceive their male students as "more competent" with regard to computer use.

D) Male teachers will have greater levels of awareness and expertise with regard to computer use.

E) Male teachers will have more favorable attitudes towards their jobs than their female counterparts.

Organization of the Study

This study is presented in five chapters. Chapter I deals with a statement of purpose and the goals of the study, statement of the problem, hypotheses, parameters, procedures, and the importance of the study.

Chapter II contains the review of the literature pertinent to this study. This chapter is broken down into two sections. The first deals with sex differences and computer use. The second deals with the different needs and special areas in education that the computer, along with appropriate software and trained personnel, has been capable of addressing.

Chapter III documents the purpose of the research. It states the research questions addressed by this study, along with hypotheses corresponding to each research question. Chapter III also details the methods that were used in this study. Information about the sampling procedures, as well as the nature of the questionnaire is presented in this section. References to appropriate appendices are also found within this chapter.

Chapter IV deals with the results that have been obtained in this study. These results are broken down into two sections: a) General Statistics; and b) Inferential Statistics. General statistics has provides a breakdown of all descriptive measures. The section on inferential statistics compares nominal, ordinal, and interval data using the techniques of Chi-Square and t-test.

Chapter V contains the discussion. A determination was made to see if the hypotheses of this study were supported. Recommendations were also proposed, based upon the findings detailed in the study.

Chapter II. Review of the Literature

This chapter deals with references that are pertinent to the study. It is divided into two sections. The first concerns itself with computer use and sex differences. It focuses upon differences in both computer use and competency levels between the sexes. It also discusses inequities and sexual stereotypes that have appeared in computer advertisements. The issue of male and female attitudes toward computer use is addressed. Finally, it focuses upon the commitment of males and females towards computer use.

The second section deals with the numerous educational needs that the computer (along with appropriate software and trained personnel) is capable of addressing. It focuses upon several different educational scenarios where the computer has been found to be a powerful support tool. The purpose of this section is to document the various needs and educational scenarios that can be enhanced through the use of computer technology.

Section 1. Sex Differences and Computer Use

There is a natural partnership between computers and mathematics. The binary system of numbers is the basis of computing (Bitter, 1989). This is in addition to the fact that programming languages overall are very logic and math oriented--specifically following the rules of both disciplines. Mathematics has traditionally been male dominated, and there is much research on the topic to support this idea. Theories behind reasons for this domination are numerous, and it would go beyond the scope of this paper to document all of them. However, it would be useful at this point to elaborate on some of the discrepancies between male and female attitudes and performances in the field of mathematics.

Maccoby and Jacklin (1974), indicate that boys outperform girls in mathematics. Meese and Parsons (1982), indicate that there is a significant difference in terms of the numbers of men and women entering mathematical fields--especially applied mathematics, like engineering, physical sciences, and computer science. This limitation of mathematical training within the gender has serious ramifications for career positions in these professional fields.

A study involving a comparison of gifted students in mathematics was conduced at Johns Hopkins University (Benbow & Stanley, 1983). Results of this study published in Science, 1983, suggest significant differences in mathematical aptitude. The study involved the administration of the mathematical portion of the Scholastic Aptitude Test (SAT) (a test normally administered to 11th and 12th graders) to groups of precocious 7 students 13 years of age and under. The number of boys and girls tested between 1980-82 was 19,883 for boys, and 19,937 for girls. What was astonishing about this study was the numerical ratio of boys to girls scoring in the upper areas on the test. The ratio of boys to girls scoring at a level of 500 was 2:1. At scores of 600, the ratio became 4.1 to 1. At scores of 700, the ratio became 13.4 to 1.

Environmental hypotheses were proposed for these observed differences, and the Hopkins researchers conducted studies into the backgrounds of the students. No significant differences in attitudes were found to exist between males and females towards mathematics (the measures for attitudes were admittedly broad, but seemed to show no significant discrepancies). Differential amounts of course-work were also suggested to account for the observed score differences. It was found, however, that students in the study seemed to have similar formal training in mathematics.

It seems clear that males in this sample dominated the upper scores on this mathematical achievement test. For whatever reasons, males were more successful, at least according to this measure.

According to a study conducted concurrently by researchers from the University of Pittsburgh and University of Michigan, there is a significant difference between males and females in regard to their enrollments in advanced mathematical courses, and in pursuing mathematically oriented and scientific careers (Meece and Parsons, 1982). Their explanation for these differences is based on a model which emphasizes social and motivational factors. A biological explanation is not ruled out, but the belief is that in order to pursue a mathematical course of study, "Natural ability is just one of the many options weighed, and that the final decision is more likely to be a consequence of a student's perception of reality than of reality itself." (Meece and Parsons, 1982, p. 343).

The decision to enroll in math is stated as being guided by:

> Core values such as achievement needs, competency needs, sex role values, and long range plans and goals. Thus, if a girl likes math, but feels that the amount of effort it will take too well is not worthwhile because it decreases the time she will have available for more preferred activities (activities that are more consistent with her personal values), she will be less likely to continue taking math. Similarly, if a girl sex types careers involving mathematics as masculine and not in line with her sex role values, she will be less likely to value mathematics learning and less likely to continue her mathematical studies, especially if she does not expect to do well. (Meece, Parsons, 1982, p. 343).

Mathematical and scientific careers have been traditionally stereotyped as male oriented. Although the field of computer science, and indeed, the use of micro-computers is relatively new, their is a perceived link between these areas. Computers have been used by scientists as a utility for the past 40 years (McKeown, 1987). Their use in business (another traditionally male dominated profession) has been ongoing for almost the same amount of time. There is research which indicates that these stereotypes may be "perpetuated" by the journals which support the use of computers.

A study published in Fall of 1988 in the Journal of Research on Computing in Education, indicated that there is bias in computer advertising from both sexual and racial standpoints. The study was conducted by reviewing advertisements in publications representing three different areas of computing: 1) systems; 2) popular computing; and 3) educational computing (Marshall, Bannon, 1988). The periodicals were Byte, Compute, and Electronic Learning respectively. Stratified random samples of advertisements containing human subjects were selected from each of the three magazines totalling 179 overall. Seventeen graduate students in Education and Psychology were used to code each of the advertisements. 35% of these coders were male, and 65% female. All were white. Each coder was given a one hour training session on how to interpret bias from several standpoints. At the end of the session, there was an 87% agreement amongst the coders when presented with the same advertisement.

Results of this study indicated that males were over- represented significantly (Chi Square analyses were performed basing expected frequencies for males on 1980 U.S. Census data) in all three publications. The worst offender was the systems magazine, in which only 27% of the advertisements showed females, and about 5% showing minorities (Marshall, Bannan, 1988, p. 21). The popular computer literature was better at representing females (46%), but not much better at representing minorities. The educational magazine was the most balanced of the publications, in that it included females in 79% of the advertisements, and minorities in 42% (Marshall, Bannan, 1988, p.21). The dominant figures, however, were still white males in all of the magazines (98.92% represented in the systems, 100% in the popular, and 100% in the education advertisements) (Marshall, Bannon, 1988, p. 22).

In terms of reinforcing traditional sex role stereotypes (where the female is in a subordinate--non-management position, or in a sexually exploited role), again, the Education Magazine was leased biased. However, all three publications demonstrated high percentages of sexual stereotypes (systems 73%, popular 76.92%, and educational 63%) (Marshall, Bannan, 1988, p. 23).

The underrepresentation of females and minorities suggest a lack of sensitivity to these groups in the educational marketplace. Even though the typical systems executive is typically white male, there are minorities within this field. The fact that stereotypes and preconceived ideas of what a computer operator "should be" or "is" may contribute to a widening of the gap between enrollments of males and females in computer courses, and similarly, between whites and minorities.

> Computer magazines that are read by adults seem to be reinforcing race and sex stereotypes. Adults reading these magazines are repeatedly provided with messages that computers are for white males and that females using computers should be in clerical or other subordinate jobs, and that females are sex objects to be used to advertise computer products. Since these messages are being reinforced over and over again, they may come so internalized that they are passed on from adult to adult in general attitudes or even employment and from adult to children in communicating expectations. (Marshall, Bannan, 1988, p. 25).

Low self esteem and expectations are already believed to be factors which contribute to the discrepancies between observed enrollments and performance in mathematics. Environmental factors may already be socializing women and minorities out of the computer field.

It should be noted that minorities have traditionally been under-represented in the area of higher education. A study conducted under the direction of Alexander Astin (1982) on a cohort of over 150,000 college students spanning the years 1972-1979 has indicated that minorities, particularly blacks and hispanics, tend to be under-represented in college environments when compared to caucasians. The problem increases in magnitude progressively through higher degrees. Whites earn even higher percentages of masters degrees and doctorates when compared to their minority counterparts. In fields related to science and mathematics, minorities tend to have even lower representation (Astin, 1982). The implication is that this will have an effect on the ethnic distribution that exists in the classroom. Since college degrees are required for educators, it is probable that minorities will be under-represented overall. Astin's data tend to support this idea. Since the field of teaching computers is mathematically oriented, the problem may be intensified further. This study has attempted to make a determination on these issues.

It is appropriate at this point to cite information concerning the perceived interest of school age students on the issue of the computer and computer programs. Kiesler, Sproull, and Eccles (1983), have suggested that females may be seriously handicapped in future computing environments due to strong male bias at early ages. They suggest that computer programs and games often have predominantly male oriented backgrounds, sports, or adventure themes. They further cite that the computer culture tends to reinforce male based behaviors such as the breaking of codes, illegally pirating software, and disabling systems.

In order to determine if students indeed have conditioned ideas on sexual factors involving computer use, Carol Johnsen and Karen Swoope conducted a study on 1st, 2nd, 3th, 7th, 9th, and 12 graders. Students were questioned on how interested they would be in: 1) using a computer; 2) using a computer program with a female oriented theme; and 3) using a computer program with a male oriented theme. The results of this study indicated that there was no significant difference between male and female interests on computer use by itself (both males and females indicated a strong interest in using computers). The study did show that theme had a strong influence on affecting interest between the sexes. Girls had a significantly higher interest in using the program with the feminine them when compared with the boys. Boys, on the other hand, had a significantly stronger interest in using the program with the male oriented them.

The importance of these findings is that it is possible to affect interest in computer use by altering the orientation of the associated software. This reinforces the idea that socialization and environmental factors can have a strong influence on who uses computers.

In the area of higher education, a study conducted by Robin Kay from the University of Toronto investigated gender difference in computer attitudes, literacy, and total commitment. The study focused on 383 students enrolled in graduate psychology and education courses at the University of Toronto. The mean age for this sample was 27.2 years. The percentages of male and female students surveyed were 33% and 67% respectively. Students in this survey group were teachers representing all grade levels.

Students were told to answer questions in the areas of: 1) Total commitment towards computers (which included interest in computers, promotion of computers, and use of computers); 2) Total attitudes (which included cognitive and affective attitudes); and 3) Total Computer Literacy (which included basic skills, application software, computer awareness, programming, and computer experience). Responses to questions in each of these categories were tabulated and statistically compared between males and females. It was found that there were significant differences between the groups in total commitment and total computer literacy. The study, however, found no difference between males and females in terms of overall attitudes (both cognitive and affective) (Kay, 1989, p. 313).

Commitment towards the use of computers was suggested as being tied towards overall knowledge (literacy). The possibility is that the more proficient someone is in using a computer, the more likely he/she will be committed towards using it in the future (Kay, 1989, p. 314).

This idea may have serious implications. Although females may have positive attitudes towards computers, they may be less likely to use and pursue the study of these machines due to a relative lack of proficiency. Increased computer literacy may increase overall perceptions in locus of control and commitment. However, "A certain degree of commitment to computers will be required before female teachers will take time out of their already busy schedules to actively acquire computer literacy skills." (Kay, 1989, p. 314). It seems that females must be actively encouraged and supported with regard to the use of the computer and the pursuit of higher computer skills.

Summary: Sex Differences and Computer Use

Mathematical differences between the sexes has been clearly documented in many different research articles. It seems that males dominate the field significantly, and that discrepancies in performance increase in the upper levels of mathematical reasoning. Differences in mathematical enrollments become pronounced at the secondary level, and even more so in higher education. This can have serious repercussions in the areas of self perception and career choices.

Scientific careers--including computer science and computer use are strongly correlated with mathematical ability. These occupations have been traditionally stereotyped as male oriented. Environmental pressures and conditioning seem to be very important factors in the formation of these individual perceptions and career goals.

Studies have shown that males and females do not differ significantly in attitudes towards computer use (this seems to be true at all levels--from primary ages through graduate school). They do reveal that factors such as attitude and proficiency can affect the willingness to use the computer. It has therefore, been suggested that educational themes that are not sexually biased be presented to computer students, and that the encouragement of females to pursue further computer skills is in order.

Studies also show that there is clear bias in computer journals with respect to gender and racial background, with white males grossly over-represented, and females and ethnic minorities under-represented. It is suggested that these biases may reinforce stereotypes that exist within society with regards to computer use, and that they may widen the gap between white males and the under-represented groups if steps are not taken to alleviate the problem.

Section 2. The Computer as Used in Addressing Multiple Student Needs

It is important to address the multiple needs of students in varied educational settings. Every educational institution, no matter what the level, has students that have different strengths and weaknesses. Institutions should ideally attempt to meet the needs of their constituencies. By meeting these educational needs, they may in fact be promoting the success rates of individuals, and thereby, the success of the institution as a whole. Success can be measured on many different levels, but certain factors may be singled out as criteria for measuring success. It would not suffice to define success purely in terms of monetary or materialistic measures. Rather, the ability of an institution to retain individual students can be thought of as important (preventing drop outs); the ability of the institution to promote logical and free thinking; the ability of the institution to help a person cope independently with the "real world;" the ability of the institution to help the individual deal with fitting into society and to become a contributing member from social and intellectual standpoints--all can be regarded as significant measures of success. An institution that could achieve these goals with 100% of the individuals it admitted would be one that could be considered quite successful. No school, college, or university, however, can make the claim that these things have been accomplished with each member of their graduating classes. It is nevertheless desirable that institutions strive toward the attainment of these "success measures."

This section focuses on how computers can help multi-faceted student populations excel in various educational settings. It is broken down into the following sections:

1) How computers have helped the educationally handicapped and the learning disabled.
2) Use of the computer to reduce drop out rates.
3) The computer as an aid in teaching young children.
4) The computer as an aid to the physical education teacher.
5) Interactive video machines.

6) Intelligent Computer Assisted Instruction.

7) Most recent developments in Intelligent Computer Assisted Instruction.

These units are preceded by a section that details the characteristics of CAI (Computer Assisted Instruction) programs. This information is pertinent to the sections that were just listed.

While reading this information, the reader should note that the computer is not a "cure-all" for educational problems in the classroom, but when properly used, it can be an extremely effective tool in promoting instruction.

CAI Defined

Computer assisted instruction has been defined as "a process in which the learner interacts directly with lessons which are displayed on a cathode ray tube or which are printed by a terminal that provides hard copy." (Grimes, 1977, p. 1). Computer assisted instruction (CAI) is usually broken down into three basic categories: 1) Drill and practice; 2) Tutorial; and 3) Simulation. It is appropriate at this point to document the differences between each of the CAI types.

Drill and practice software can be thought of as programs that "randomly generate practice exercises for students to complete." (Bitter, 1984, p. 389). The student is asked to answer the questions, and is informed as to whether or not his/her responses are correct. The degree of sophistication of such programs varies--from those which simply ask questions to those which tap the graphics, animation, and sound capabilities of the computer to stimulate interest. This can help avoid one of the problems with drill and practice, which is that frequently, these programs are perceived as tedious or uninteresting (Bitter, 1984). Properly written programs have ways of informing the students of heir correct and incorrect responses, and will also provide positive feedback for correct responses. Drill and practice programs are usually sued to reinforce concepts and ideas already presented in a regular classroom setting.

The second type of CAI software is tutorial. Under this category, the computer presents a concept or topic to the student. This is essentially a lesson presented on the computer screen. Tutorial software is more sophisticated than drill and practice because usually, these programs must take into account various levels of student ability (Bitter, 1984). Because programming is more difficult, good tutorial type software is not widely available. Tutorials are often used to help reinforce or enrich ideas that have already been presented by conventional means. After the lesson has been presented, the student is then quizzed on the material to insure mastery. From this standpoint, tutorial programs overlap slightly with drill and practice type routines (Bitter, 1984).

Simulations--In this type of program, the student is placed in a "real life" situation or scenario. Decision making skills are stressed, where the student must then deal with the consequences of his/her decisions. Information is most commonly entered via the keyboard, joysticks, or paddles. Graphics and animation are generally fundamental components of this type of programming. The student is interacting in a way that in many respects is very close to the "real thing" (Bitter, 1984).

Simulations have the benefit of providing training for individuals under circumstances where a real life situation may be too difficult to set up, too expensive, too dangerous, or too time consuming. The student can interact with the computer, and if he/she fails or makes a mistake, the results are not catastrophic.

Because of the graphics, animation, and audio effects that are generally built into simulations, these types of programs are amongst the most difficult to write. The full capabilities of the microcomputer are used, but because of the time involved in writing these programs, it is again difficult to find good simulation programs for all topic areas. This is one area, however, that holds much promise for the future (Bitter, 1984).

Given the basic information regarding CAI, it may be useful to detail some of its practical applications. The first application deals with the educationally handicapped and the learning disabled.

How Computers Have Helped the Educationally Handicapped and the Learning Disabled

Exceptional children are those who are thought of as differing from normal children in one or more of the following ways: 1) communication abilities; 2) sensory abilities; 3) social behavior; and 4) physical characteristics. Computer assisted instruction has helped provide special education teachers with the means of educating exceptional children in the areas of basic reading, arithmetic skills, writing, individualized programs, and game strategies. The following information documents how the computer was used successfully in the areas mentioned.

The computer has been used as a means of teaching geography to learning disabled and remedial students. A study conducted in 1988 by Horton, Lovitt, and Stocum in 1988, compares two methods of teaching geographical locations to learning disabled and remedial high school level students. Lessons were presented that were intended to convey the locations of twenty-eight major cities in Asia. The first group was given an atlas and was instructed to transcribe their findings to a work map. The second group was given a computerized map tutorial (Horton, 1988, p. 322). The program was designed in such a way as to provide interaction, immediate corrective feedback, instruction in a logical sequence, and a comprehensive review. The program was run using a MacIntosh computer, and the students were allowed to progress at their own pace. Tess were administered prior to the instruction sequences, and post tests were also administered. The results of the post test indicated that students on the computer program averaged 85% correct as opposed to 19% correct for the students using the conventional instruction. These results indicate that CAI provides a considerable improvement over conventional instruction.

The researchers suggested the following reasons for greater success with the computerized instruction: 1) Students felt as though they were playing a game, and actually enjoyed searching for and learning to memorize the cities; 2) the mouse controlled response allowed the students to focus their attention on the monitor rather than the keyboard data entry system (Horton, 1988, p. 379).

In the area of word recognition, speed and accuracy are two important elements (Cohen, 1988). This is one of the primary deficits of learning disabled children, which ultimately affects the ability of these children to comprehend the overall meaning of what is written (Cohen, 1988, p. 333). The computer was used in a program to:

> provide a highly structured, mastery oriented practice to sight and word vocabulary of reading disabled children. By sight word vocabulary, we mean words that are rapidly identified without having to use analytic decoding strategies. (Cohen, 1988, p. 334).

The students in this study were chosen on the basis of having scored in reading skill, one standard deviation below their scores on general intelligence. Ages of these students ranged from about nine to thirteen years of age. Pre-tests and post-tests were administered to these students. Training was administered with a software package entitled "Words." The training lasted for approximately nine weeks (Cohen, 1988).

The results of this study showed that the program was able to allow students to attain large improvements in spelling and quick word recognition. The researchers believe that programs such as "Words" can provide successful learning experiences during "the extended process of becoming able to read text independently and fluently." (Cohen, 1988, p. 340).

Such programs may be particularly useful to students with poor analytic decoding skills. Subsequent administration of reading materials that contain new words that the child might otherwise not have recognized may then be possible. This can facilitate the overall process of learning to read more complex materials fluently (Cohen, 1988, p. 340).

In the area of motivation, computer games (sometimes overlapping with tutorial and simulation type CAI programs) have been found to be very successful in stimulating interest and continued persistence in instructional material (Malouf, 1988, p. 27). Motivation increases seem to be particularly high amongst those students with low initial motivation and academic deficiencies. The results are less significant, and indeed, motivation can even be decreased by applying these programs with already high initial motivation (Malouf, 1988, p. 35). The use of instructional computer games has been advocated by several researchers: Chaffin, Maxwell & Thompson, 1982; Driskell & Duger, 1984; Hofmeister, 1982; as explained below.

Continuing motivation is defined as "returning to a task or behavior without apparent external pressure to do so when other behavior alternatives are available" (Malouf, 1988, p. 27). The idea of using instructional games to stimulate this motivation is based on the ideas that instructional games have a number of motivational characteristics including clear goals, immediate feedback, scores which reflect improvement, high response rates, audio/visual stimuli, randomness, multiple levels of difficulty, and fantasy (Malone, 1981). These features make the computer a potentially powerful tool in coaxing participation and enthusiasm from even the most reluctant individuals.

The study conducted by David Malouf in 1988 centered around twenty-five students ranging in grade levels from sixth through eighth. The students were from a suburban middle school,and all of them were identified as learning disabled. Students were given essentially three different activities: A) A free choice vocabulary activity; B) a non game computer vocabulary activity; and C) a game computer vocabulary activity. The free choice and non game computer activities were of a drill and practice nature. Subjects were found to deviate markedly in their tendencies to remain on tasks between the game and non-game activities. Response rates increased in terms of number of items completed, and students remained on task longer. There was also a stronger tendency to return to the computer game instruction than the non game scenarios. Furthermore, performance increased from 25.9% on the pretest to 85.0% on the post-test administered after instruction. Reasons for increased motivation may stem from the fact that the games "influenced self perceptions of self efficacy, task competence, or task interest" (Malouf, 1988, p. 36). It is also thought that classical conditioning may be part of the motivational increases (rewards spark motivation). The game provided stronger positive reinforcement for rapid responding than the non game program.

What is most important is that instructional computer games can affect the willingness to learn, and can affect student behavior beyond the times in which the student is actually playing the game. The significant increase in post-test performance over pre-test performance demonstrates this idea. Further research for instruction in broader areas are necessary.

In the area of writing ability (essay construction, revision, etc.), the computer is a promising avenue for not only learning disabled students, but average and above average achievers as well. Word processing programs may provide students with an entirely new way to create and modify text--with advantages that extend well beyond typical writing methods.

It has been found that students using word processors tend to make more revisions of text (from 2 to 5 times more)than with ordinary handwriting (MacArthur, Graham, 1988). The length of text also seems to increase significantly--from 50% to 140% above normal writing. The number of spelling, capitalization, and punctuation errors is reduced. Finally, the overall quality of text has been judged to improve by objective external readers (MacArthur, Graham, 1988).

From an affective standpoint, students became more confident of their ability to write good text. Students seem to have more enthusiasm towards writing, and a greater perception of self confidence. Increased motivation, again, is a key issue.

Reasons for the observed behaviors may be explained by the following: 1) Students may be more willing to consider revisions because the laborious task of recopying is eliminated: 2) Concerns about the neatness of the paper and "messy" mistakes are alleviated; 3) The word processor makes it possible to manipulate, insert, or delete and rearrange text; 4) Students are able to concentrate on the material itself, rather than the chore of actually handwriting (Moore, 1984). Clearly, the use of wordprocessing to promote writing ability shows much promise, and is something which deserves further study.

To conclude this section on the learning disabled, information on a study involving CAI to help mainstream LD students in more cognitively complex areas will be presented.

Placing LD students in a regular classroom presents several problems. Essentially, LD students perform more slowly than their non-handicapped counter-parts. The problem of dealing with diversified rates of assimilation is critical. A study conducted by D. Carmine concentrated on the utilization of CAI to teach LD students skills in reading comprehension, content area instruction, math problem solving, and critical thinking (Carnine, 1989, p. 524).

In the area of vocabulary skills training, LD students were assigned work using a CAI program that could deal with the students individually. The students were able to progress at a faster rate than was possible during direct teacher instruction (lecture) (Carnine, 1989). The requirement of the teacher having to spend more time with both the regular students and the mainstreamed LD students at the same time was removed. More effective time management and teacher interaction were the result.

In the other curriculum areas, CAI was found to be very helpful in facilitating the instruction of the entire class. Again, instruction effectiveness was increased as "the demands on the teacher were reduced" (Carnine, 1989, p. 532). The computer was effective in helping LD students narrow the gap of academic performance levels between themselves and their non-handicapped peers.

Overall, studies indicate that the computer is a major asset in dealing with this portion of a diversified population. To summarize, CAI programs have been proven effective in the areas of geography instruction, word recognition, promoting and sustaining motivation to accomplish lessons, improving writing ability, developing positive attitudes and confidence in learning, improving the quality of learning, and finally, partially alleviating the problem of diversified rates of learning by allowing mainstreamed students to keep paced with their non-handicapped classmates. This last effect was associated with a reduced load on the teacher, who was then able to manage classroom time more effectively, and provide a higher quality of instruction in areas where it was really needed. These encouraging results are demonstrated when the computer is used properly, and the sequence of learning events is planned out carefully. The importance of the idea that educators be knowledgeable of the proper uses of the computer and its associated software cannot be overemphasized.

Use of the Computer to Reduce Drop Out Rates

In 1984, the drop out rate at Pensacola High in Escambia County, Florida, was about 40%. This was not at high as the 50% rate found at other Florida schools with large "at risk" populations (Gross, 1989). Students in these high risk groups often have trouble with schoolwork, are beset by troubles at home, and are likely candidates for dropping out. The situation in Florida was aggravated by the fact that the state mandated minimum graduation requirements (Gross, 1989). Schools began to lose students that had learning problems in addition to those that were seriously disadvantaged (Gross, 1989.)

John Dewitt, the Escambia School District's Director of Research and Grants, in association with members from Florida's Job Training Partnership Act (JTPA), began to look for a solution to this serious dropout problem. The computer was deemed as the most promising tool to use. The decision was made to focus on a CAI system that was:

> ...based on sound learning theory and would not add extra work for teacher. It would not only help students with generic skills development, but would correlate with Florida's Student Assessment Test by providing practice in the types of questions on the competency test required for graduation. The program they envisioned would give students immediate feedback and offer teachers an on demand readout of a student's status and progress. In addition, it would serve the needs of students grades 1-12, of adults returning for their

> GEDs, and of gifted students, as well as those in need of remedial help. Finally, the program would diagnose performance levels for each student and prescribe work in separate skill areas within each subject. For example, for an 8th grader with uneven development, it would provide problems at a 4.8 grade level in division, at a 6.2 level in addition, and at a 3.7 level in fractions. (Gross, 1989, p. 50).

The system that was determined to meet these requirements was created by the Computer Curriculum Corporation (CCC) of Palo Alto, California--initiated by Patrick Suppes of Stanford University (Gross, 1989). This system had been successfully implemented and used in "hundreds of school districts". (Gross, 1989, p. 50).

When the system was implemented at Pensacola High (a total of 16 terminals on a mainframe), within six months, only 2 of 374 "at risk" students dropped out. In this six month period, students on this system, by spending twenty minutes a day, were found to have covered one to two years of academic material. Due to this encouraging success, the number of terminals in the district was increased to 88 in six area schools, and the drop out rate as of 1988 was less than 1% of the verified JTPA at risk students (Gross, 1989).

Escambia is not the only district that has seen success with the implementation of CAI. In 1984, Calvert County's school system was 12th out of 24 in Maryland, based upon scores attained on the California Achievement Test. After implementing the same system used at Escambia, "82% of the students scored above the national average, with 25% in the ninth stanine in math, and 11% in the ninth stanine in reading. Scores in the lowest three stanines have been virtually eliminated with only 2.5% of the students in that category" (Gross, 1989, p. 51).

In Lafayette, Louisiana, a federally supported eight week training program was administered to high drop out risk adolescents and young adults above 14 years of age from economically deprived backgrounds. The CCC program was again used. A total of 15 hours of instruction was provided in math, and 14.2 hours in reading. Results of this study showed that students acquired mean gains of 1.5 grade equivalents in math, and 1.2 grade equivalents in reading (Hotard, Cortez, 1987). On criterion referenced post tests, these students were found to be competent in math for a variety of skilled jobs, and were able to do problems they had never seen before (Hotard, Cortez, 1987). Moreover, dramatic attitudinal shifts were observed. Students became highly motivated, and self confidence and self concept were positively affected (Hotard and Cortez, 1987).

A number of explanations can be cited to account for the improved performance and attitudes that have been observed in these different scenarios.

First, the computer will go to an easier level if students miss several problems of a particular type, regardless of if a tutorial is presented. Conversely, it will advance them if they get several problems of a particular type correct, to prevent boredom (Gross, 1989).

Next, the computer will create problems by choosing random numbers. In this way, if a student needs extra help in a particular area, he/she will not feel as though he/she is going through redundant routines.

Third, the computer provides positive feedback and at random intervals. Different types of comments and feedback are part of this system. On the other end of the scale, mistakes that are made are not public, so no embarrassment will occur if a student gets a problem wrong.

In the affective domain, students are demonstrating a change in their perception of "Locus of Control." Shirley Thornton administered "Locus of Control: Intellectual Academic Responsibility Questionnaire" to students in the San Francisco bay area to see the effects that the CCC program had had.

> Six weeks on the CCC system convinced them that it wasn't fate or popularity, but work that would affect their advancement in life. Their locus of control had shown remarkable shifts from the outside in. (Thornton, 1985, p. 50).

According to Eugene Karol, Calvert County's School Superintendent:

> CAI results tell the story. The average 8th grader is performing in language arts at the 12th grade level, reads at the 11th grade level, and computes at the 10th grade level. That's the

> average. Our average IQ is 107. It's ordinary kids doing extraordinary work. (Gross, 1989, p. 50).

CAI is not a cure-all for the drop out problem. Districts must have the means, the facilities, and the knowledge of how to implement such systems effectively. Furthermore, support from faculty and administrators is essential. Also, students will not gain social skills, question asking skills, and the ability to deal with situations that don't have a "right" or "wrong" answer. These are areas that must be provided from areas of instruction outside the computer. Nevertheless, the computer does provide the possibility for widespread success with students who have not had much of a chance in the past.

The Computer as an aid in Teaching Young Children

Many researchers believe that the computer can be a very useful tool in educating young children. To be useful, it must be integrated properly into the classroom. Kevin Swick (1989) has stated that the computer must: 1) Be integrated into the natural context of the classroom; and 2) Be used as an interactive device. The idea of using the computer as an occasional tool for periodic activities should be avoided. This is so that children will ultimately see the computer as a relevant part of their ongoing learning activities.

Research has shown that when the computer is implemented in an appropriate manner with young children, many benefits result. First, the computer enriches existing instruction by allowing students the use of various sensory and perceptual modes (Audio, visual, tactile). Next, there is the potential for building self confidence. Third, the computer can reinforce social skills, such as team planning and cooperative learning (Beaty and Tucker, 1987).

The computer is a device which allows many different types of input devices. Information can be entered via the keyboard, joystick, light pen, mouse, trackball, touch pad, etc. (McKeown, 1987). Furthermore, an individual can respond to many types of output--visual, from the computer monitor, auditory, from a speaker, hard-copies from a printer, and even synthesized speech from a voice module (McKeown, 1987). Since different people have different sensory strengths, the computer can allow a student to utilize the mode(s) most appropriate to him/her.

The computer can build self confidence in a number of different ways. Young children respond to positive reinforcement created by some CAI packages. Seymour Papert notes that the computer also provides young children with the means of "controlling technology" for their uses (Papert, 1980). Children get the chance to operate the machine--turning it on and off, loading and saving programs, operating the various peripheral devices, etc. Beaty and Tucker note:

> The initial introduction between child and computer is crucial to the continuing relationship. Children need to be in control from the beginning. If children are not allowed to touch the computer during the first session, they may be reluctant to use it during future sessions. (Beaty & Tucker, 1987, p. 19).

Often, the computer is introduced to young students in groups. Sometimes this is due to a lack of equipment. But this type of situation can provide some positive outcomes. This is because by using the computer in this way, certain issues will inevitably develop, such as: Whose turn is it?; How do we run the programs?; How do we keep the machine clean? These are issues that children will discuss, and resolve while interacting in their groups. Children are thereby not only learning about technology, but also are strengthening their social skills, inventiveness, and creativity (Swick, 1989).

In the areas of stimulating creativity and motivation, certain instructional games have been found to be particularly effective. One program entitled "Jeepers Creepers" is a mix and match animal game. Children are shown a picture of an animal divided into three parts. The child (using a keyboard) is asked to manipulate the body parts and/or mix combinations of parts. Assembly of the animal correctly is one possible solution. The key here is that children are given a chance to experiment and create. The children using this program have demonstrated high degrees of interest in continued use.

Another interesting program known as "Sticky Bear Opposites," is designed for use with very young children. Here, students are given a chance to explore shapes, sizes, and colors. It is a preliminary introduction to geometry--where children can manipulate and experiment with objects in two dimensions (Swick, 1989).

Mathematics instruction is one of the areas which has some very great possibilities for CAI application. A study conducted by Richard Binswanger at Agnes Irwin School in Rosemont, Pennsylvania, involved teaching the concept of perimeter to 4th grade girls. Some of the observations noted by Binswanger prior to using computers were that the girls seemed afraid to take risks--they were regurgitating rote memorized answers rather than thinking through solutions, and were not particularly interested in pursuing possibilities that might exist behind a concept. Binswanger decided to circumvent these problems by using LOGO to help the girls gain an understanding of perimeter--which also has the concepts of identities, fractions, and square roots tied within. A lab equipped with Apple IIe computers was used. The students had had no previous formal training in LOGO, and were taught how to manipulate the "turtle" to draw geometric forms. The fact that the students had no previous training proved beneficial, since this meant that there were no preconceived ideas or notions about using the program (Binswanger, 1989). Several exercises were administered where the students were asked to draw differently shaped objects that had the same perimeter, to calculate the areas of these objects, to break dimensions down into fractional units, and to devise as many combinations of lengths and widths as possible to meet certain parameters (Binswanger, 1989).

Observations that were noted in this study were: 1) Students were enthusiastic and motivated to work with the computer; 2) Students inevitably returned to work even after encountering frustrating problems; 3) Students became discovery oriented "searching" through fundamental properties of geometry and mathematics; 4) Students were able to combine geometry and arithmetic--seeing how they were related (Binswanger, 1989). Although much of the work could have been performed using paper and pencil, the computer allowed students to create geometric figures that were very accurate, easy to manipulate, and that were easily visible and accessible (Binswanger, 1989). Cooperative learning was another positive side effect. Overall, students were learning math in ways they had never done before, and were doing things that they never even thought were possible.

It is appropriate to mention some ideas on the use of word processing programs with young children. Word processing packages have been found to "promote both guided and unstructured learning" (Swick, 1989, p. 8). There are two programs that have been found to be particularly useful in early childhood education: Bankstreet Writer; and Stickybear Printer. Bankstreet Writer provides a simple, comprehensive word processing package that is suitable for novice computer users. Stickybear Printer gives children more options. This package includes graphics and picture forms that can be integrated into the text, so that students can make up stories to go along with the pictures (Swick, 1989). Use of these programs provides students with different means of learning how to record text, and has demonstrated increased performance and motivation.

The computer can provide the means for learning music. Programs have been written which allow young children to manipulate sounds, and invent rhythmic patterns. Musical notes can be matched to keyboard letters. Essentially, children are allowed to control and manipulate musical tones in any way they wish (Swick, 1989).

Drawing and painting are also important areas in which young children may "discover." A number of skills are tapped and reinforced with these art oriented software packages. Among these are hand eye coordination, pattern creation and recognition, geometric patterning, and the use of fine motor skills (Swick, 1989). Numerous other programs exist which foster early artistic development (Swick, 1989).

Young children can benefit greatly from the implementation of the computer in their curriculums. The computer addresses the diversities of curriculum content, student abilities, and learning styles. If the computer is implemented properly, attention can be devoted to areas that have not been fostered in the past. Alternate learning styles can be promoted. The key is to integrate the computer in the classroom by carefully planning how it will be used in each area and level of instruction.

The Computer as an aid to the Physical Education Teacher

Very little research has been done in using the computer in physical education. Yet, this is an area that can have potentially great benefits from its implementation. PE instructors have a wide variety of programs to choose from that will help them manage their classes. This includes software packages that can help them maintain orderly records, keep important data on their students, generate tests, create information sheets for students, and obtain information from other PE teachers on relevant issues through the use of telecommunications networks (computer bulletin boards), among other possibilities. Technically, the uses mentioned above fall under the category of computer managed instruction (CMI). It will be useful to elaborate on a few of these areas.

Wordprocessing--this is a function that can be of great use to PE teachers. The creation of ditto-masters for distribution to students (classroom rules, game rules, objectives, expectations, etc) can be done in a word processing program, where mistakes can be edited easily. This can be particularly important when creating a master that ideally, should be error free. Files can be retrieved for use at a later date (like the next time the class is taught, so the "wheel does not have to be invented' each semester) (Hurwitz, 1985).

Utilities such as test generators (some very good public domain packages are available) can be used for quizzing students on the academic aspects of a course. Questions can be entered into a data file, and the program can then be used to create tests by randomly selecting the questions. This is a process that can save a large amount of time--which can then be devoted to other activities (Hurwitz, 1985).

Spreadsheets provide the teacher with the ability to tabulate data on a set of students, including proficiency at various activities, desired levels of proficiency, whether the student meets the minimum standards, etc. Records can be updated neatly and accurately. Diagnosing the needs of individual students is made easier. Attention to the details of what each student has accomplished (individualized instruction) is facilitated. Furthermore, the spreadsheet automatically updates overall averages whenever new data is entered. This can speed the process of assigning grades (Hurwitz, 1985). The ability to tabulate and modify data is particularly significant when the overall number of students a particular PE teacher has is taken into account. Hand calculation of such information is simple, but very time consuming when dealing with large quantities.

The computer can provide the means by which individuals within a common area of interest or profession can share information. Communication between various schools on teaching strategies, special activities, meeting dates, etc. are usually part of such network systems. Information can be exchanged via electronic mail (e-mail) between individuals (personal messages), or groups (bulletin boards). The importance of keeping abreast of current information is important to all disciplines including physical education (Hurwitz, 1985).

Certain software packages exist which can assist students in certain aspects of logic and reasoning, visual thinking and spatial perception, and inductive reasoning abilities. One example of such a program is entitled "The Factory" (Kosel, Fish, 1983). The abilities stated are important for students in many P.E. activities (the cognitive skills are important in scoring games). Students having difficulty with these thinking processes can be given individualized attention with the computer (the computer has been used by P.E. teachers to help students in these areas, with marked success) (Hurwitz, 1985). In this way, P.E. can be a more "rounded" experience (Hurwitz, 1985).

One of the greatest possibilities for the computer in physical education is in the area of data management. The computer can make the processing of information less time consuming. It can also increase the teacher's ability to store information on individual students (Mayhew, Rankin, 1983). Database programs are the types of software most appropriate in this area of application. There are two types of database programs that can be used--generic and area specific. Generic programs (for instance, R-base 5000, D-base III+, or Appleworks) offer a great deal of flexibility and large amounts of storage space (Kelly, 1987). Such programs can allow an individual to tailor the categories of desired information to his/her own needs. As much or as little information on each student can be built into each data file. The disadvantages of such systems is that usually they are costly (one can expect to pay up to several hundred dollars for a good database package), and they require a high level of expertise (or training to acquire the expertise) which may not be in line with the desires or time constraints imposed upon a teacher (McKeown, 1988).

The second alternative is the database program that is written specifically for a PE data storage application. Programs such as these are usually less costly (some are even public domain) and much more "user friendly." However, the trade off is that they are less flexible, and may not have the ability to store all of the desired information expected by the teacher (Kelly, 1987).

The greatest advantage of database programs is that they allow the teacher to easily create reports. Databases can allow Individual Reports, Summary Reports, Statistic Reports, and Status Reports (Kelly, 1987).

Individual Reports--these types of reports can inform students and/or parents of progress being made with regards to course content. Information can be obtained on the exact status of an individual within a variety of categories (for instance, leg strength, abdominal strength, tennis serve, tennis rules, etc.). In this way, steps can be taken by the individual to improve his/her performance within areas that require work (Kelly, 1987).

Summary Reports--these reports give information to the teacher in the middle of a course. Under normal circumstances, a teacher can give a pretest and a post test during the course of a physical education unit. Time demands in manipulating data usually do not allow for assessment at any other times (Kelly, 1987). With the computer, on the other hand, a teacher can generate a report at any instance, and in this way, can give proper feedback at appropriate intervals. This increases the student's chance for success (Kelly, 1987). Teachers may also use summary reports as a means of showing that their teaching has been effective. Information can be summarized on class performance within specific goals and objectives, to see if "success" has been attained in these areas. The process of sifting through 3-400 individual documents is accomplished by using the computer. (Kelly, 1987).

Statistic reports are those which give special statistical information on students. Percentiles, means, modes, etc. are some of the information provided. Certain database programs can allow for more in depth statistical analyses (Kelly, 1987). This, however, usually goes beyond the scope of an ordinary PE class.

Status Reports--are the last category. These are hard copies (actual printouts) of all of the information that has been entered into the database. This allows for a comprehensive review of stored material. Subsequent analyses of performance are conducted, and possible areas of improvement can be isolated (Kelly, 1987).

Overall, database programs make the task of storing and reviewing information on individual students less cumbersome. By using these packages, PE teachers can devote more time to alleviating weaknesses in student performance, and also in developing and enhancing student strengths. More time is actually spent teaching, rather than on secondary data manipulation tasks. It should also be noted that the use of database programs can be applied to other classroom situations--academic areas, to provide information to teachers in these disciplines as well.

Another area of application is in the field of motor learning and control. This area is being developed because of the versatility of the microcomputer as a "recording device" for different input mediums. Microcomputers are easily capable of recording reaction time and movement time (Engelhorn, 1983). "These parameters are important in many different situations (in physical education)" (Engelhorn, 1983, p. 30). It is possible to perform experiments involving reaction time and movement time on classes to obtain data sets that can be analyzed statistically. Individuals and groups can be studied and compared, and steps can be taken to provide these students with appropriate activities (Engelhorn, 1983). The computer provides accurate and reliable information--data which is not subject to compounded errors as in the instances where humans do the timing (Track coaches, for instance, require precise timing for numerous events. The placement of appropriate switches--both pressure and electronic, feeding into a microcomputer, can provide data much more reliable and accurate than a human timer) (Engelhorn, 1983).

Motion analysis is another aspect of motor learning and control. Through the use of microcomputers, analog/digital convertors, and accelerometers (all of which are connected to the microcomputer), a student's physical movements can be closely analyzed. Motor learning applications and kinematic data are extremely important to many types of sport coaching. To illustrate:

> A power weight lifting coach requires knowledge of the pattern of muscular activity and movement and acceleration patterns of the weight bar. This information, if available immediately, could then be used by the coach for technique adjustments during a training session. An ideal pattern or sequence of muscle interaction may be known or theorized for comparison with the actual data collected on each performance. (Engelhorn, 1983, p. 32).

> Learning of many sport skills can be significantly enhanced through the use of a microcomputer for the immediate feedback of movement performance information. (Engelhorn, 1983, p. 32).

A lack of knowledge of such systems would seem to be one oft he major stumbling blocks to their widespread implementation. Initial expenses and maintenance costs for this equipment (since it would be used frequently, and in conditions much harsher than a typical microcomputer lab) must also be primary considerations in dealing with this issue. However, one cannot overlook the numerous benefits that these systems can provide.

Finally, microcomputers have been used successfully in fitness testing (stress test analyses). One of the advantages of the microcomputer in this area is that it can simultaneously monitor and operate multiple pieces of testing equipment. At Nebraska's Kearney State College, an Apple II+ was used to control timing, a treadmill, an electrocardiograph, a blood pressure monitor, a pulse indicator, and a speedometer, all at the same time (Donnelly, 1983). The computer was able to record the data provided by these instruments at regular intervals, precisely, and without delay. Adjustments could be made to alter the conditions of the testing simply by hitting a few keys on the Apple II keyboard. Given these conditions, it was possible for a single person to run the stress test. Previously, such an analysis required the presence of four trained individuals, who were required to work in unison, and who were also responsible for recording data by hand as the test proceeded (Donnelly, 1983). Implementing the microcomputer makes the task of running such an analysis less time consuming and expensive--not only in terms of personnel, but also in the fact that less equipment would need to be purchased to create visual outputs for each of the measuring devices used in this kind of operation (Donnelly, 1983).

It seems clear that the microcomputer is capable of addressing diverse problems in the field of physical education. As mentioned previously, this device is not normally thought of as a "standard" piece of equipment in a PE department. There are, surprisingly, many different areas that it is capable of addressing, and aiding within this discipline.

Interactive Video Machines

One of the newest technology areas that is currently being developed is the field of interactive video. Compact laser disks have provided the capacity to store very large amounts of information--both text and pictorial. Graphics--especially high resolution graphics, have been traditionally difficult to store in the past because of the large amounts of computer memory they require (McKeown, 1987). The development of the Laser Disk as a storage medium has alleviated the problem of limited storage space, so that now, vast amounts of information can be saved and recalled with the proper equipment (Ito, 1988).

The idea of using video to instruct students has research support. Studies have indicated that "video is not necessarily a passive medium; there is evidence that students are very active as they watch an educational television program" (Laurillard, 1984, p. 7). Students have been found to enjoy information presented in this format, so the motivational aspects of learning are enhanced (Laurillard, 1984). Studies have also provided convincing evidence that student control over a learning activity is educationally effective (Hartley, 1981). Interactive video provides the opportunity for students to control many of the ways in which information is presented. Sequences of information presentation can be altered, the pace of presentation can be increased, slowed, or even reversed, and the student obtains information using different senses.

> Interactive videodiscs foster communication and learning using sight, sound, and touch. The viewer interacts with a video presentation by a remote control keypad, a "light" pen, a mouse, or by simply touching the monitor's screen. With a built in micro-processor or an external computer program, elaborate "branching" sequences of a videodisc program are possible. The result is a versatile and virtually infinite medium for transfering information (Watkins, 1988).

The video disk system gives the learner more diverse ways of obtaining and working with information. The system also has the advantage of providing immediate feedback to the user:

> Utilizing a microprocessor control, which allows for branching instruction, users can access segments of various media being used in a particular system with speed and accuracy. The learner receives information, is asked questions, and can respond electronically using a responder device. Feedback can be immediate and personalized, while the information's level of difficulty can be channeled to match the individual's pace and rate of learning. Remedial information can be presented automatically, and some systems can record and evaluate the learner's performance. (Simcoe, 1983, p. 12).

The software that accompanies the disk will be what determines the overall quality of the presentation. The best programs will provide the capabilities mentioned above.

There are essentially three types of video disk players. Level I players have the video disk player and a remote control that can access the disk's contents. Presentations can be made in a linear fashion. These are not considered interactive (Ito, 1988). Level II machines are more sophisticated. These contain microprocessors, which allow them to be programmed. Certain discs have programs encoded on them already so that when the user is viewing the disc, he/she can work interactively with the disc using a remote control (Ito, 1988). As an example, a person may wish to call up restaurant data from a disc on travel information. He/she could accomplish this by responding to menu prompts using the remote control. Level III players are "state of the art." These can be interfaced with computers from personal to mainframe (Ito, 1988). The computer can provide questions, branch to different video sequences (to control the level and area of instruction), and allow the user to input information at any time. This is where true inter-activity can occur. Type III units are also the most durable and expensive (generally starting around $1000.00) (Ito, 1988). The future of interactive video lies within the use of the Level III machine. Because the technology is new, initial costs are predictively high. As the market matures, sophistication can be expected to increase in association with a decrease in average cost (Ito, 1988).

The Macintosh computer is an ideal machine for use with the interactive video disc player (Ito, 1988). This is due to the fact that the Macintosh can use "hypercard stacks" which can be programmed into the machine. These are essentially "guided tours" through the content of the video disk (there are many other uses for hypercard stacks which go beyond the scope of discussion here). The Macintosh's ICON operating system makes the use of these machines relatively simple, since there are pictures or labelled boxes that indicate specific functions (McKeown, 1988). It is possible to select from a number of options when going through a video disk presentation. For example, one company

(Optical Data) offers disks and hypercard stacks in the areas of earth science, life science, and physical science. The packages come with:

> five disks full of stacks, including one that contained the auto demo. The stacks are all linked, and in addition to the standard functions, they'll perform keyword searches that will list and show frames or sequences with criteria that match the keyword. Included are a glossary of terms, a tours stack that will store a custom 'video lesson,' and a mark and edit stack that enables users to compile their own programs. (Ito, 1988, p. 214).

Teachers can use the mark and edit stacks to create their own "tours" or lessons through the data. Information may be inserted at any point within the stack. This data can be obtained from other stacks, or the teacher may create his/her own. The teacher is in complete control over the content and logic of the presentation. Overall, this can be a powerful tool that helps create visual lessons for multiple uses.

Visual materials can be administered to large groups using interactive video. It can serve as a means of demonstrating the steps that occur through different physical processes to students. These can be presented at any speed to help promote comprehension. Tests can also be administered using interactive video.

> Teachers can break free from the constraints of textbooks, and the chalkboard. They can back up their imagination with classroom materials they have been dreaming about. Concepts that are difficult to explain, such as meiosis, become clear when you can freeze a frame on a videodisc and discuss it with students. (Ambron, 1988, p. 11).

Schools, and in particular, school libraries can benefit from interactive videodisc technology. Video glossaries have large collections of slides and still pictures. Information from the Louvre, the National Air and Space Museum, the Art Institute of Chicago, etc., are some of the compilations that exist. There are discs available on many aspects of science and mathematics, history, social studies, art, and medicine. There are even picture based encyclopedia discs available from Grolier (Van Horn, 1988). Students can make use of interactive video for utilities such as desktop publishing, special projects, and writing. It is possible for these students to communicate ideas to a class in new ways--especially those students who may have had difficulty in expressing ideas by other means (Ambron, 1988). One side of a disc can hold 54,000 individual pictures. If both sides are utilized, there are a total of 108,000 possible illustrations overall. This translates to about thirty minutes of motion video per side (Miller, 1988, p. 4). From the standpoint of a "slide presentation," the interactive video disc presents the possibility for a greater quantity and quality of available picture materials. Furthermore, since the disc is read by a laser, there is no deterioration that occurs each time it is read. Discs can have an unlimited life-span if cared for properly (Van Horn, 1988).

Interactive video can be a powerful tool in dealing with diversity in education. It provides a number of ways in which teachers can present material. It also promotes the possibility of teaching students using more than one sensory mode. Research has indicated that motivation is increased, and that students can obtain broad topic perspectives from the use of interactive video. Aside from the initial costs, once an institution has the equipment, a teacher should be able to make use of it indefinitely since the discs themselves never wear out. Technology is also likely to bring the overall costs of these machines to more affordable levels.

Intelligent Computer Assisted Instruction

The trend in the development of CAI software is towards more sophisticated programs that address the needs of the user. Educational researchers, computer scientists, and educational psychologists are moving towards programs that are able to:

1. Answer questions posed by students.
2. Process natural language (English).
3. Assess problems that individual students have with subject matter.
4. Have knowledge bases of a particular topic area.

(Kearsely, 1987, 5-6).

By adding these capabilities to the computer, instruction more closely parallels the ways in which real teachers teach. Elaboration on each of these abilities is appropriate.

1) The ability to answer questions is something that is almost never found in ordinary CAI programs. Students are usually presented with choices on "menu screens," but are not given the chance to ask anything specifically (Bitter, 1984). By creating a program that can answer questions, a large number of potential learning obstacles are removed. The student is able to obtain explanations of what is going wrong.

2) Natural language processing is the ability of the computer to understand ordinary sentences. Anyone who has ever programmed a computer realizes that the computer only "understands" a limited number of instructions that must be entered in a proper sequence (syntax) (Apple BASIC). Artificial Intelligence researchers have attempted to program computer grammar that creates English sentences, recognizes and corrects ambiguous statements, and deals with different ways of saying the same thing (McGrath, 1984). Generally, the greatest success occurs when there are a limited number of words, phrases, and facts to deal with. Much work will be required to accomplish reasonable inroads in this area (Kearsely, 1987).

3. Assessing Student Problems. The computer must be able to identify problems that the student is having and "understand" the errors that a student is making when attempting to master certain materials. The computer must be aware of what the student knows and needs to know (Kearsely, 1987). Part of the tutoring process will involve asking the student questions at the appropriate time. Responses given by the student will allow the computer to supply the necessary information to the student.

4. Knowledge representation refers to the connection of knowledge within the data base of a program such that an inter- related network of information exists (McGrath,

1984). The computer can then use this information to answer questions posed by the student on any given piece of subject matter.

Programs capable of performing the elements just mentioned fall under the category of Intelligent Computer Assisted Instruction (ICAI). The approach is radically different from conventional CAI because the teaching methods and interactions are much closer to those found between regular teachers and students. The main advantage is that the student now has an individual "tutor."

Examples of ICAI

A program used in the early 1970's called "Scholar" gave the student a tutorial on the geography of South America. "Scholar had so much information that it appeared to really `know' the geography of South America." (McGrath, 1984, p. 42). Specific attention was paid to natural language processing, so that the student could interact freely with the program, and ask questions at will. The program also had the capacity to recognize possible mis-spellings of words. Scholar would provide questions to quiz the student on information presented, and would also offer appropriate positive reinforcement for correct answers. Its overall approach is much more sophisticated than normal CAI, and can be considered revolutionary, especially when one considers the time frame from which it originated.

Another example of ICAI is found in a program called BUGGY developed at Stanford University in the late 1970's (McGrath, 1984). "This program is referred to as a procedural network program; its data base includes both correct and incorrect mathematical procedures. The first program searches for an incorrect procedure (simulating a student's problem solving method) and shows an example of it. Then teachers must figure out how to determine what this incorrect problem solving method is." (McGrath, 1984, p. 41).

Buggy essentially finds the "Bugs" in a student's algorithm. By diagnosing the incorrect method, the teacher's job is simply to correct the area where the student has gone wrong. Again, traditional CAI programs would not be able to carry out such a sophisticated procedure. They would simply indicate whether a response was correct or not.

The reasons why ICAI programs are not prevalent in our educational systems are two-fold. First, the ability for early microcomputer to run such software was almost non-existent. Memory limitations and processing speeds did not allow for the running of such software (Wilson, 1985). The development of more miniaturized computer chips, however, has resulted in personal computers that have the same computing capacities as those of large "mainframe systems" of just 10 years ago. Such innovations mean that the potential for implementation of ICAI software is great.

The second, and probably more serious reason is the fact that ICAI software is difficult to produce. It is hard enough to find people able to write good conventional CAI programs. The people able to write ICAI software are even more scarce. Knowledge of these systems is very limited, and usually they required the cooperation of experts from various fields (Kearsely, 1987). Moreover, entering the amounts of information in these programs is a formidable task, not to mention creating an inter-related network of this information. Because of these difficulties, it may take some time before the widespread use of ICAI becomes commonplace. This type of system, however, still remains as one of the brightest prospects for the future of education.

Possible Ramifications of ICAI

If all instructional programs utilized ICAI methods, it might be possible to foster situations where education is more individualized. Under these circumstances, the student becomes less reliant upon the teacher because he/she is able to ask questions of the computer. Because each student is given an individualized tutorial, it may be possible for a more rapid progression through the subject matter (yes, American educators are always concerned about the aspect of time!). More importantly, however, is that research with other types of CAI indicate that the retention of subject matter taught via the computer is generally superior when compared to conventional instruction methods (Grimes, 1977). It seems possible then, that the student will not only save time, but perhaps gain an increased quality of learning.

It still seems unlikely that the computer will serve as a replacement for the classroom teacher. The teacher still needs to provide the structure that seems necessary for learning to occur. Furthermore, ICAI programs still represent an aspect of instruction--not complete and total teaching. They will serve as a device to improve the quality of teaching, and the tools that the classroom teacher possesses. Further research in this area will be needed to clarify the direction which these systems will take.

Most Recent Developments in ICAI

Development of ICAI programs may be expedited by the fact that software developers have been working on the creation of expert system "shells." These shells provide the basic framework for an expert system (ICAI package) that can then be tailored to a specific function or use (Lippert, 1987).

Until recently, most expert systems were created as problem solving programs for use in industry. Examples of such programs are MYCIN (used in medicine), and PROSPECT (used in geology) (Lippert, 1987). MYCIN was designed to help physicians diagnose afflictions occurring in patients, and PROSPECT has been used as a tool in geologic exploration--determining the best places to obtain economically productive mineral sources (Kearsely, 1987). Both programs require that the user provide information to the program. The system then makes a choice on what diagnoses or actions are appropriate--based upon a comparison of input data with the system's own knowledge base (Lippert, 1987).

Educational uses of expert systems are still in their infancy. Yet, with the development of superior technology and shell structures, it may become possible to utilize these systems on a much wider scale.

In the area of mathematics and science instruction, expert systems are seen as a potentially powerful tool in conveying critical thinking skills (primarily reinforcing analytical thinking, synthesis, and evaluation). Lippert states that too often, students are perceived:

> ...as a repository rather than as a processor of information ì and experience. It (educational practice) tends to be more concerned with what answers are given than with how they were produced. Students often learn to solve problems without ì adopting a through understanding of conceptualization underlying correct solutions. This leads to an inevitable memorization of formulae, problems are solved by merely plugging values into variables. The result is that students practice their manipulative skills, while the content are never really grasped ì and therefore forgotten within a short time. This leads to superficial learning, with very little transfer potential. (Lippert, 1987, pp. 477-78).

Because of these perceived deficiencies in American science and mathematics students (who will ultimately be part of the U.S. work-force), certain private companies have dedicated millions of dollars in funds to research methods of improving skills in these vitally important areas (Greeno, 1986). The focus of this research has been on what can be done to improve problem solving techniques.

It has been noted that when confronted with a new topic or situation in which a problem must be solved, the novice will follow a behavior which involves: a) unsystematic exploration; b) inadequacy in expressing and defining a problem; c) restricted inferential thinking; and d) impaired strategies for hypothesis testing (Lippert, 1987).

For many students, the difficulty of the solution lies in finding the appropriate scheme, due to an unawareness of both dimensions of the problem, and the communication of the solution in a systematic way. As novices, they attempt to recall a solution, while experts perceive a problem as a task of analysis and reason. (Lippert, 1987, p. 480).

To solve a problem efficiently, students must have an adequate understanding of a problem. Their representation of the problem must be coherent--elements of the problem must be interrelated in a logical and well organized fashion, and the representation must be integrated within the world of the problem solver's knowledge (Greeno, 1977).

Expert systems can be used to help enhance a subject's understanding of a problem. By increasing the knowledge base of the subject in a stepwise and logical pattern, the subject can ultimately gain a sufficient understanding of a situation such that a reasonable solution can be applied. The structure of the expert system is what allows the student to progress in this sequence.

Expert system shells provide areas for the implementation of a knowledge base. There are questions which are designed to extract information from the student. There are also a list of rules that branch from the answers to questions to possible decisions. The shell also has the capacity to include explanations to rules and questions, so that a user can understand why a question is being asked or why a rule is being implemented.

The subject of physics has been commonly perceived as very difficult by students, because it requires a detailed understanding of the subject matter. It is not possible to rely upon regurgitative techniques when solving problems in this area, because each problem presents its own unique aberrations. The solution to a particular problem involves almost always involves the use of a series of IF--THEN rules, NOT, AND, and OR logic. The following sequence illustrates how an expert system deals with the topic of forces.

Computer: Q1--Which forces are acting on the object?

1. gravitational
2. centripetal
3. friction
4. tension in a string
5 all of the above

6. none
7. 1 and 2
(...etc.)

Student: Why?

Computer: The more forces acting on an object, the more formulas need to be considered in the solution. Forces are vectors. Their composite effect determines in what direction the object will move.

Computer: Q2--Is the object in:

1. free-fall?
2. circular motion?
3. sliding in a plane?
4. following curvalinear motion?
5. none of these

Student: Why?

Computer: This determines the particular equations that must be used.

Computer: Q3--Has it reached terminal velocity?

1. Yes
2. No

Student: Why?

Computer: Knowing this might simplify the equation, since if it is no longer accelerating, acceleration = 0.

Typical decisions could be:

D1: The total force on the object exceeds its weight

D2: Newton's 2nd law states that....

D3: The force has a horizontal as well as a vertical component.

D4: Use the equation T + mg = F = ma

Typical rules might include:

R1: If Q1a1 and Q1a4 then D4

R2: If Q2a4 then D3

R3: If Q1a3 and Q2a3 then D1

(Lippert, 1983, pp. 483-84).

The sequence stated above demonstrates the networked knowledge, and the logical sequence the computer uses to help the student arrive at a solution. The student is an active participant in the learning process, not only prompting the computer to continue, but also analyzing and deciding on each course of action. The student is forced to perceive all of the options that are possible, and to choose which ones are appropriate for a particular situation. If a student makes an incorrect choice, ultimately, the computer will find an error in the student's reasoning. The student also has the option of reviewing the entire sequence of logic undertaken by initiating a series of "why" prompts.

Utilization of the shell structure has numerous advantages. As students gain an understanding of the rudiments in a field, the program can be extended to incorporate more advanced areas in the subject. For instance, physics students in this example might be given questions on momentum, statics, and energy. Information can be integrated--new concepts extending (yet based upon) the old. Furthermore, it is possible to extend this knowledge so that it is integrated into other disciplines. This type of system can be applied to all branches of science and mathematics. It may also have instructional applications in the fields of engineering, computer science, computer information systems, life sciences, and even psychology. Expert systems seem to provide a better way of approaching problem solving when compared to traditional drill and practice or tutorial routines. The fact that shell structures can be modified make this avenue of instruction even more attractive, since programs can be specialized to meet specific needs.

Only when the formal structure of the problem is perceived correctly can missing data be appreciated, and surplus information draw attention to the necessary and sufficient conditions inherent in the inter-relationships. Students can plot their decisions and associated rules in a tree format as they respond to the prompts of the shell, thus seeing the hierarchical structure, sub-sumptions and branching they built. They can correct, expand, or erase features and retest the rule-base over and over again--until they are persuaded that their representation is complete and correct (Lippert, 1987, p. 490).

It should be noted that it is important that the individuals responsible for using these systems have a thorough mastery of not only the subject matter, but of the capabilities of such an expert system. Time will undoubtedly need to be devoted to learning how to effectively use such a program. Teachers in the classroom should probably be trained in the use of such systems if they are to be used on a district-wide basis. The same pitfalls that exist for conventional CAI may be magnified greatly under these circumstances if care to meet these provisions is not made. Adequate instruction can avoid a plethora of problems and difficulties.

Teaching by the Socratic Method

Expert systems provide the possibility for instruction to students that can be much more stimulating than traditional CAI methods. Programs can be constructed in ways such that they encourage students to seek out new knowledge, rather than having it handed to them. Researchers at Yale University have been developing sophisticated software that does not necessarily answer an inquiry directly (Port, 1988). Instead, a series of questions and answers designed to get students to think about what is transpiring are administered to lead them through to a desired outcome. According to Robert Shank, Chairman of Yale's Computer Science department:

> Our program will teach biology to children by helping them create their own animal. If the child tells the computer to start with a cow's body, but with larger ears...the program tells him about the value of big ears. As the child continues to play with design, the computer conveys more and more information about biological systems. But the program never tells you anything unless you need to know it (Port, 1988, p. 54).

This approach to education is aimed at stimulating interest in the subject. The idea that a child is experimenting with different concepts and techniques, and is following his/her own unique path through the program, means that he/she is tailoring an individualized instructional sequence. Further information on how students react to this program, and an analysis of attentiveness to this as opposed to other programs would prove revealing.

Teaching English to Adults

In Great Britain, expert systems have been utilized to help convey English to adult speakers of foreign language. The system used in this instance focused on "a functional approach to language stressing teaching language as communication rather than concentrating entirely on syntax and grammar, and construction of a system that can answer questions rather than merely drill" (Ewing, 1988, p. 938). It was hoped to make the experience relevant to the needs of adults in the "real world."

The topic of diet was selected as the them for these lessons. Learners across different cultures have a universal interest and appreciation for this topic (Ewing, 1988). The program was broken down into three components.

The first was a software package designed to allow students to ask questions about the food or what the ingredients are contained within certain meals or recipes (working on a knowledge base).

The second package was an expert system on diet, which was based upon 30 rules. Users were asked to respond to yes/no questions, and to indicate their degrees of certainty on a +5 to -5 scale.

The third program gave advice on nutritional value--aspects such as nutrients, vitamins, and calorie content. The program also presents information on methods of cooking and vocabulary. The database of the program is expandable so that as new questions arise, they can be accommodated by the instructor.

Preliminary results indicate that this program was successful in conveying concepts to students. The approach is quite different from ordinary foreign language courses, which concentrate on totally different methods of presentation. Success with this system may provide the basis for a new type of efficient language instruction.

Intelligent Systems in Reading Instruction

Preliminary work on an expert system designed specifically for student teachers of reading is being undertaken at the Northern College of Education--Dundee Campus, Dundee, Scotland, under the direction of James Ewing. This program is intended to convey the principles of good practice and the typical decisions made by experienced reading teachers. A cooperative effort between programmers and experienced reading teachers is in progress to help create a large database that can be queried by student teachers of reading. These individuals can see what types of decisions are made everyday during the process of teaching reading. "Students should gain a wider knowledge base against which to relate their own judgement of what they see happening in the classroom during teaching practice" (Ewing, 1988, p. 936). This program seems like a promising avenue that could possibly be used with many different student teachers in this subject area. The possibility also exists where this type of system could be expanded to other teaching areas as well. It is always encouraging to discover new methods of improving the quality of instruction.

Intelligent Systems in Air Traffic Control

The use of artificial intelligence in education extends into realms other primary and secondary teaching. In Britain, civil air traffic controller cadets are being trained with the use of an expert system. The system contains within its core an extensive knowledge base gathered from experienced air traffic controllers. It is designed to help instruct students by guiding them through an extensive course that monitors the progress and pace of each student individually. Detailed records of student performance are stored--creating a "profile" of each student in the program. The skill level of each student is noted--down to strengths and weaknesses within particular topic areas (Watts, 1988).

Subject matter in this program is supplied in the forms of computer graphics, text, and video. The strength of this software is that it presents an excellent "real life" simulation. When the system was presented to some of Britain's most experienced air traffic controllers, they were astounded by its uncanny ability to pick out their most significant weaknesses.

The clever part of the system is that it notes the student's mistakes continuously. It has its own knowledge of what each of the vehicles on the airfield wants to do, and whether each is satisfied with the commands it receives. (Watts, 1988, p. 40).

One of the problems that has traditionally faced air traffic control is that the brightest students who perform extremely well in the classroom "freeze up" when confronted with the real thing. The expert simulation system is something that can hopefully bridge the gap, or ease the transition into the real world.
(Watts, 1988).

The potential for expert systems is very great. Preliminary observations indicate that this particular system is an excellent educational tool. If time and resources are devoted to the creation of such programs in other subject areas, it may be possible to revolutionize instruction--specifically, the quality of instruction that individual students receive. With reduced costs for superior technology, these types of software are likely to become more commonplace--espcially if their performance meets or exceeds the expectations of the designers.

Voice Recognition

One of the great difficulties in making programs more user friendly is in trying to get them to process natural language. Besides the thousands of rules governing the structure of the English language, there are the problems of syntax, double meanings, contextual use, etc. (Kearsely, 1987). There is also the problem of how individuals speak differently. The computer must be able to distinguish between different accents, rates of speech, voice inflexions, etc. Great progress is being made in the area of voice recognition. A company known as Logica has indicated that it has a system of voice recognition that is almost 100% accurate (Watts, 1988). This system, unlike other software in this area, concentrates on many aspects of the individual's speech. Previous programs attempted to focus on only one aspect. By limiting the focus in this way, communicating over mediums such as telephone lines (which restrict the frequency of sound passing over the line) could destroy the computer's ability to recognize a given individual. The mood of the person, shape of their face at a particular instance, and state of the vocal tract were other variables which affected the one aspect approach (Watts, 1988).

Logica's method does the following:

It analyses each speech signal it receives. It then uses a sophisticated mathematical model to compare the signal with the database of users it has stored in its memory; to see if it recognizes the person who is calling (Watts, 1988, p. 40).

It is necessary for the programmers of this system to have "voice blueprints," so that a database of stored users will exist for the system to reference. By tying this in with a language recognition system known as Vodis, the company claims to be the first company in the world that can recognize continuous speech (Vodis is an automated system designed to guide callers through train time-tables. Note that the application is extremely limited). Because of their success, Logica has won three large grants from the European Research Programme in Information Technology (Watts, 1988).

Perfection of a language recognition system can have tremendous benefits in the area of ICAI. It seems as though technology is improving in this area at a rapid rate. If this technology can be incorporated into other instructional areas, it may be possible for a whole series of user friendly, intelligent packages to proliferate. What makes this so significant is that there are still a large number of teachers in the classroom who are computer illiterate. These individuals may tend to have phobias concerning computer use. By creating an environment in which a person can control the computer through voice commands, rather than complicated series of keystrokes and/or pointing and clicking operations with a mouse, it is probable that an even greater numbers of teachers will have the motivation and confidence to use the device. Students will also be benefactors, as they will be able to communicate with the computer in ways that more closely approximate interactions with real teachers. Cooperation between different software manufacturers could have a significant impact on how quickly subsequent future developments proceed.

Recent developments in educational programming, and other technological software indicates that the world is progressing towards more competent and sophisticated educational systems. Expert systems seem more ubiquitous than in the past, largely due to easily modified shell type programs. If teachers are made aware of the possibilities that exist in this area of instruction, it is possible that great improvements in the quality of instruction can be realized. Systems such as these still require large amounts of training to facilitate proper use and application. It is unlikely that an average teacher would be left to his/her own devices to run such programs. Yet, obstacles such as these should not prevent policy makers from attempting to tap this potentially valuable educational resource.

Because constant improvements and advances are being made in microcomputer technology, it is likely that we will see some interesting developments--perhaps revolutions in the immediate future.

Summary

The issue of dealing with the educational needs of students is multifaceted. From the standpoint of dealing with students alone, it can be seen that there are many problems facing the classroom teacher. The varied nature of the student population is what makes a 100% success rate difficult to achieve for any educational institution.

The literature has shown that the computer is a device that can be very useful in dealing with multifaceted populations. It is capable of working with a student on a one to one basis (individualized attention), it can operate indefinitely without ever fatiguing or getting bored, and it can allow students to progress at their own paces. Research has demonstrated that the computer is helpful in dealing with the learning disabled--marked improvements in performance in many different instructional areas have been demonstrated when the computer has been used with this group. Research has also shown that the computer is successful in helping "at risk" students--especially by helping them to stay in school. It can be used with regular classes to improve skills in almost every academic area. Use of computer technology with young children has shown that it can provide them with self confidence, motivation, improvement in performance within different subject areas, and the ability to learn using various sensory modes.

In the area of physical education, the computer can help teachers deal with a diverse set of problems. It can provide the means for more effective management of instruction in many different areas. It can help students deal with cognitive skills that are applied in P.E.

It can also help P.E. teachers improve their instruction through the use of techniques such as motion analysis and fitness testing.

Interactive video is another promising area of development. Here, the computer can help teachers develop instructional programs that are highly motivational, and that provide material from areas that were previously very difficult to access. Initial costs in this area are a major stumbling block, but advancements in technology will probably help to reduce the magnitude of this problem.

Finally, one of the most promising areas of software development is in the field of Intelligent Computer Assisted Instruction (ICAI). Programs of this type more closely approximate the ways in which real teachers teach. These packages may ultimately help those students who do not function well with conventional CAI packages (either because the packages are too limited so students get bored, or because the quality of instruction is lacking). It will also address the problem of dealing with those individuals who might find the computer too impersonal. ICAI affords the capabilities of natural language processing, inter-related data networks, and diagnostic analyses. Voice recognition and speech synthesis are also areas that have the potential to enhance instruction by providing students with more "human like" interaction. These developments may provide students and teachers with the ability to control the computer through the use of verbal communication, rather than the use of the keyboard and mouse, which by comparison, require higher degrees of expertise to use. These programs are the most sophisticated types of CAI software.

It should be noted that care must be exercised in utilizing the computer. In the research documented, users of the computer and associated software were knowledgeable of the capabilities that existed. Proper implementation of CAI involves careful planning and foresight. Programs cannot be developed haphazardly. If they are, the computer can be worse than useless.

The computer should not be viewed as a cure-all for the problems of educational diversity. It is a very powerful tool that has the potential for improving and enhancing education well above existing levels. Further research on how it can be used for these purposes would seem imperative at this time. The issue of how aware current computer teachers are of the many areas the computer can address would be one of singular importance. If technology is to be used in education effectively, those individuals who directly control technology in the schools should be knowledgeable about the various uses of the computer in different subject areas and curriculums. It is these people who will be responsible for facilitating the widespread use of technology. This study will attempt to determine the degree of awareness that currently exists within the teaching population.

Chapter III. Research Quesions and Methods

The review of the literature has indicated that there are sex difference that exist with regard the the pursuit of mathematically oriented careers. Males have a greater tendency to focus upon careers related to science, mathematics and engineering when compared to females. The implication is that males may be over-represented as computer teachers in the classroom. Sexual stereo-types and bias have been observed in computer advertisements appearing in a number of different publication types, including those that are educational in nature. The possibility is that children may be "socialized" into thinking that the computer is a tool for males rather than females. Studies have also suggested that males have superior levels of computer literacy and commitment towards the use of computers (Kay, 1989). This finding suggests that males may tend to pursue computer oriented careers, including that of computer teacher with greater frequency than females.

On the issue of ethnicity, the literature also indicates that minorities in education appear to be under-represented when compared to caucasians. In particular, blacks and hispanics seem to be lacking in scientific and mathematically oriented careers. The proportion of blacks and hispanics who receive baccalaureate degrees is low when compared to caucasians. This raises the possibility that blacks and hispanics will be under-represented as teachers in the classroom, since teachers are required to have college degrees. This could mean that the ethnic breakdown of teachers in the classroom is not representative of the over-all student populace.

With regard to the use of the computer as an instructional tool, the literature has shown that when implemented properly the device can be of great benefit to the classroom teacher in meeting a variety of special student needs. The computer has been shown as an effective tool in working with the learning disabled and handicapped, young children, and "at risk" students. The computer has also been seen as a powerful tool in managing the classroom, improving writing skills, and improving mathematical skills. New fields such as Interactive Video and Intelligent Computer Assisted Instruction have the potential to revolutionize the way that the computer is used in the classroom.

The fact that these technologies are being developed and are changing so rapidly, means that considerable effort must be expended to stay abreast of these changes. Computer teachers in the classroom should be aware of the developments that are transpiring. Similarly, they should be obtaining experience with some of the technologies that are more readily accessible such as interactive video.

The issues discussed above raise several questions on what conditions currently exist in the classroom.

Purposes of This Study

The intent of this study has been to gather information on the state of educational technology in the classroom. The following research questions have been be asked:

1) How do male and female computer teachers compare in terms of professional preparation and experience?
2) What are the demographics of computer teachers currently in the classroom?
3) How do computer teachers perceive their male and female students?
4) What levels of proficiency and expertise currently exist in the classroom among computer teachers?
5) What are the attitudes of computer teachers in the field?

To answer the first question, males and females were compared on criteria such as the number of computer classes completed; the number of math courses completed; professional computer workshops attended and years of experience using the computer. It was anticipated that males would have greater levels of experience in the use of the computer, as studies have shown that males tend to pursue college course-work in mathematical and scientific fields with greater frequency than their female counterparts (Astin, 1982). The computer field has long been associated with the field of mathematics, and the computer industry itself is male oriented. Advertisements for computers and software in periodicals and journals (even educational journals) tend to have strong male bias. This study attempted to determine if the trend of male domination has been carried into public school classrooms as well.

The second question is related to the first. The intent was to determine if males are over-represented when compared to their female counterparts. The expectation was that there would be a dominant male population in the classroom. This question is important since the role models presented in the classroom can have an effect on student attitudes and perceptions. If students themselves perceive the computer as "a tool for boys or men," then this might have an adverse effect on female enrollments in later computer classes and computer oriented careers as well.

The third question has attempted to focus upon teacher perceptions of their own students. Specifically, the question of how sexual stereotypes affect student performance in computer classes has been asked asked. Computer teachers were instructed to provide information on how interested they perceive males and females to be in using the computer. The amount of exposure to the computer that each sex receives was determined. The question of how teachers feel society affects male and female attitudes towards computer use was presented. Finally, teachers were questioned on their perceptions of how they feel computer companies solicit business--from male or female clientele. The hypothesis here was that teachers would perceive their male students as more interested and proficient in the use of the computer than their female students.

The fourth question has focused upon awareness and competence levels with respect to the different aspects of educational technology. Computer teachers were asked about their knowledge and expertise in fields such as artificial intelligence and expert systems; interactive video; use of the computer across several disciplines; use of the computer in stimulating higher thinking skills; use of the computer with the learning disabled; use of word processing to stimulate writing skills; and use of the computer in teaching by the "discovery method." Teachers were also asked about their perceptions of the computer as a diagnostic tool; as a device that can make the most effective use of a student's sensory/perceptual modes; and as a machine that can enhance and facilitate the learning process. Finally, they were asked questions concerning the existing state of educational hardware and software, and what future possibilities might be.

As facilitators in the field of educational technology, it is important that teachers are aware of the latest developments that are transpiring. New technologies will not be used unless there are individuals capable of implementing them. It seems clear that individuals cannot implement a technology of which they are unaware. Given the knowledge of the capabilities that the latest developments in educational technology can afford, it is possible that a high level of interest may be stimulated in pursuing advanced course-work within the field. It was anticipated that male teachers would have a greater awareness of the different areas in educational technology than female teachers.

The fifth question in this study has focused upon attitudes of computer teachers in the field. The question of how computer teachers obtained their current occupations was raised, in addition to the satisfaction levels of these individuals with their current careers. The intention was to determine if a significant number of computer teachers were "forced into their current positions as state law mandated computer literacy. It seems clear that if a teacher is dis-satisfied with his/her position, he/she will be less likely to pursue further knowledge within the field. There is also the danger that a negative attitude towards the computer from the teacher will be conveyed to the students as well. The attitudes of male and female computer teachers were compared. It was anticipated that male teachers would have more favorable attitudes towards the job than their female counterparts.

By determining the demographics of individuals actively involved in the teaching of computers, in addition to expertise, awareness, and satisfaction levels of these teachers, it was hoped that this study could provide insight on the status of computer education, and that recommendations concerning curriculum content in educational computer technology programs could be based upon the findings of this study.

Hypotheses

With regard to the research questions posed, the following hypotheses were suggested:

A) It is anticipated that males will have greater levels of professional preparation and experience.

B) Males will predominate as computer teachers in the classroom. Females will be under-represented.

C) Teachers will perceive their male students as being more interested in computer use. Teachers will also perceive their male students as "more competent" with regard to computer use.

D) Male teachers will have greater levels of awareness and expertise with regard to computer use.

E) Male teachers will have more favorable attitudes towards their jobs than their female counterparts.

Methods

Computer teachers in Orange County schools were presented with a questionnaire that focused on several different areas (See Appendix A). Specifically, computer teachers in every unified school district in Orange County were surveyed in this study. Surveys were distributed to a total of 301 schools. A total of 160 (N=160) teachers responded overall. This represented a response rate of fifty-three percent (53%). Private schools were excluded from the sampling. Enrollments in private schools tend to be small, so it is rare to find a private school where a teacher would teach computer classses exclusively. Additionally, the backgrounds of private school teachers can vary over a wide range. Teachers in private schools often have no valid teaching credentials, so it is possible for an individual to teach in a private school without having obtained a college degree. Finally, only those students with special backgrounds and/or resources are able to attend private schools.

Orange County was selected because it is an area that covers broad levels of social and economic diversity. There are also districts in Orange County that have committed themselves to the use of technology in the classroom on a widespread basis. Computer teachers from primary schools, middle schools, and high schools were all part of the survey sample. The questionnaire was accompanied by a cover letter documenting the purposes of the study (See Appendix B). Follow up letters were distributed to the same teachers in an attempt to obtain a high response rate (See Appendix C). Teachers were informed that their participation was voluntary, but would be greatly appreciated, and that the results of this study would hopefully ultimately expand the awareness levels of policy makers on the issue of technology use in education.

The survey contained four types of questions. First, there were questions which were designed to determine background information on the teachers in the sample--demographics and professional preparation. This section also documented experience and mathematical preparation. The following questions were asked:

1) Age?

2) Sex?

3) Ethnicity?

4) Teaching Grade level?

5) Number of years using the computer?

6) Years of experience teaching computers?

7) Number of college computer courses taken?

8) Number of high school computer courses taken?

9) Do you own a personal computer?

10) Do you teach basic computer literacy?

11) Do you teach computer programming?

11b) Are you qualified to teach computer programming?

12) List all the computers in which you have experience.

13) Do you teach word processing?

13b) Are you qualified to teach word processing?

14) Do you teach the use of spreadsheet packages?

14b) Are you qualified to teach the use of spreadsheet packages?

15) Do you teach the use of data base programs?

15b) Are you qualified to teach the use of data base programs?

16) Do you teach using Computer Assisted Instruction programs?

17) Do you give in service training for other teachers in your district?

18) Did you actively pursue the job that you have teaching computers?

19) Were you "forced" into the job that you have teaching computers?

20) Number of math courses you had in college?

21) Number of math course you had in high school?

The next section asked teachers about their perceptions of computer use among boys and girls. These questions used a Likert Scale, in which: 4 = Strongly Agree; 3 = Agree; 2 = Disagree; and 1 = Strongly Disagree. The questions were as follows:

A) Boys tend to use the computer more than girls;

B) Boys are more interested in the computer than girls;

C) Boys have greater abilities in using the computer than girls;

D) Computer ads in magazines are male dominated;

E) Computer ads in newspapers are male dominated;

F) Society tends to socialize boys towards computer use more so than girls.

G) Male and female students receive equal amounts of exposure to computers during their primary school years.

H) Male and female students receive equal amounts of exposure to the computer during their secondary school years.

The third section of this questionnaire was designed to determine the levels of awareness and expertise among the teachers in this study. The same four point Likert scale was used. The questions in this section were:

1) The computer can be an effective tool in helping the learning disabled;

2) The computer can be an effective tool in addressing the issue of diversity in schools;

3) The computer can be effective in enhancing the writing process;

4) The computer can be effective in promoting literacy;

5) Computers are becoming more user friendly;

6) I am proficient in the area of ICAI (Intelligent Computer Assisted Instruction);

7) The computer is an effective aid for the physical education teacher;

8) I am knowledgeable in the field of Interactive Video;

9) Interactive Video is a tool that can be effectively used across many disciplines;

10) Interactive Video is a tool that can effectively enhance classroom presentations;

11) Interactive video can be an effective tool in individualizing instruction;

12) The computer will be able to process English sentences thereby eliminating the need for structured programming;

13) The computer is an effective aid in stimulating higher thinking skills in young children;

14) Computer Assisted Instruction provides improved levels of instruction to students;

15) The computer will eventually replace the classroom teacher;

16) The computer promotes higher reasoning skills in high school students;

17) The computer promotes higher reasoning skills in middle school students;

18) The computer promotes higher reasoning skills in elementary school students;

19) The computer is effective in promoting and enhancing creativity;

20) The computer is capable of teaching creativity;

21) The computer can be useful to mathematics teachers;

22) The computer can be useful to English teachers;

23) The computer can be useful to social studies teachers;

24) The computer can be useful to history teachers;

25) The computer can be useful to science teachers;

26) The computer can be useful to music teachers;

27) The computer can be useful to art teachers;

28) The computer allows the student to make the greatest use of his/her strongest sensory perceptual mode (i.e. audio learners, visual learners, etc.);

29) The computer can be effective in diagnosing the problems that students have in learning;

30) Computers are moving towards the eventual processing of all instructions using natural language;

31) Computers can be used to effectively teach forcing language;

32) Use of the computer in instruction results in greater advancements in performance for students overall;

33) PE teachers routinely use computers to help manage their classes;

34) There are currently adequate numbers of computers in individual classrooms for teachers to use;

35) Computers can be effective in training students by the Socratic Method (Discovery learning);

36) I am aware of the use of expert computer systems in the field of education;

37) The use of word-processing results in a higher quality of writing from students;

38) Computers are increasing in their abilities to emulate human decision making skills;

39) Computers currently teach students in ways that exactly parallel human teaching methods (Computers teach the way that teachers do);

40) Businesses are making greater use of the computer in training employees;

41) If students do not receive training in technology in public schools, they will be at a great disadvantage later in life;

42) Computers reduce the amount of time necessary to train students;

43) The quality of instructional software is currently very high;

44) The quality of instructional software is continually improving;

45) The effectiveness of the computer as an instructional tool is limited by the existing available instructional software;

46) The ability of teachers to use technology is limited by the amount of hardware available to them;

47) The effectiveness of the computer as an instructional tool is limited by the quality of existing instructional software;

47b) The effectiveness of the computer as an instructional tool limited by the expertise of the teacher with regards to the hardware and software that he/she is using;

48) Simulations are the most effective types of CAI software;

49) Tutorials are the most effective type of CAI software;

50) Drill and practice programs are the most effective types of CAI software;

51) Expert systems are the most effective types of CAI software;

52) Teachers currently in the public school system are in need of greater amounts of training in the field of Educational Technology;

53) Administrators in the public school system are aware of the potential benefits that exist from implementing technology in education;

54) The computer promotes a higher quality of writing in students;

55) Students using word processors tend to write greater amounts of text;

56) Students using word processing tend to edit their documents with greater frequency;

57) I have used the computer in working specifically with learning disabled students;

58) I have used the computer as a tool in promoting writing skills in my students;

59) I have used the computer specifically for the purpose of working with "At risk students." (Students in danger of failing and/or dropping out of school).

60) I have used the computer as a tool in diagnosing the problems that students have with specific subject matter;

61) I have used the computer specifically for the purpose of teaching higher level thinking skills in my students;

62) I have used the computer to help individualize instruction

The fourth section of this survey dealt with current satisfaction levels of computer teachers. The same four point Likert scale was used in this section. Teachers were asked to respond to the following:

I) I was "forced" to accept the job that I have teaching computers;

II) I enjoy teaching computer classes;

III) I would prefer to teach classes other than computer classes;

IV) I teach computer classes because these are the only ones that are currently available to me.

Results of this survey were tabulated and analyzed statistically. Descriptive statistics were compiled on respondents to give an over-all picture of background, experience, levels of awareness, perceived competencies, and satisfaction levels in the field. To compare male and female teachers on nominal level measures, the inferential technique of Chi Square Analysis was used. On interval level measures, the technique of t-test was used to compare male and female respondents. Both descriptive and inferential statistics appear in following sections.

Chapter IV. Results of the Study

This chapter details the results obtained for the study overall. The chapter has been broken down into two units. The first deals with descriptive statistics compiled on the sample. In this unit, numbers have been presented on: a) General Background Information including demographics, and professional preparation and experience; b) Teacher perceptions of student computer use; c) Awareness levels in educational technology; d) Levels of proficiency in educational technology; and e) Satisfaction levels of computer teachers.

The second unit contains inferential statistics. Males and females in this unit have been compared on nominal, ordinal, and interval level measures. The comparisons were conducted over the same categories mentioned for unit 1. Chi-square analysis was used to compare males and females on nominal level measures, and the technique of t-test was used to compare males and females on ordinal and interval level measures.

Section I. General Statistics

The following section contains general descriptive statistics on the sample studied. The total number of respondents was 160 (N = 160). This represents a fifty -three percent (53%) response rate overall--questionnaires were sent to schools in every unified school district in Orange County, California. The following table provides a breakdown on age of the respondents:

Table 1
Age (N=156)

Category	pct	n
Below 22	5.1%	8
31 - 40	24.4%	38
41 - 50	47.4%	74
Over 50	23.1%	36

This data indicates that the majority of computer teachers in Orange County schools tend to be older (70.5% exist in the upper two age categories). The immediate implication is that there will be a large number of retirements occuring in the next 10 to 15 years, with a resulting need for replacements in the field.

Table 2
Sex (N=159)

	Study	n	OC Teachers Overall
Male	29.6%	47	29%
Female	70.4%	112	71%

Contrary to initial hypotheses, females outnumbered males by a margin of almost 2.4 : 1. It might seem that females were over-represented when compared to their male counterparts. However, when compared to the gender breakdown for Orange County as a whole, it can be seen that the numbers obtained in this study are very close to overall county percentages (County numbers were obtained from CBEDS data for 1989).

Table 3
Ethnicity (N=157)

Ethnic Background	Study	n	State Pct	OC Teachers	OC Census
Caucasian	91.1%	143	69.7%	91.0%	80.0%
Asian-American	1.3%	2	5.0%	2.0%	4.4%
Afro-American	0.0%	0	7.0%	1.0%	1.2%
Hispanic	5.7%	9	17.4%	5.0%	13.6%
American Indian	1.3%	2	0.9%	1.0%	0.8%

Whites tended to dominate this field. Other ethnic groups appeared to be under-represented. What was most surprising was that there were no blacks appearing in this sample. When compared to census data available for the state of California, and even when compared to general demographic information available for Orange County, it seems clear that blacks and hispanics in particular, are under-represented. However, the numbers obtained for this study do appear to match the general ethnic breakdown for teachers in Orange County as a whole.

Table 4
Teaching Grade Level (N=160)

grade	pct	n
K - 6	55.0%	88
7 - 8	18.1%	29
9 - 12	26.9%	43

The data in this table corresponds well with the breakdown of questionnaires sent to the different schools. The category with the most schools numerically was elementary, followed by high schools, and finally middle schools.

Table 5
Measures of Experience and Preparation

Topic	Mean	Std. Dev.	N
Number of years using the computer	6.39	1.91	156
Years of experience in teaching computers	5.01	2.35	158
Number of College Computer Courses Taken	3.42	2.94	153
Number of high school computer courses taken	0.14	0.65	156
Number of math courses taken in college	2.97	2.44	140
Number of math courses taken in high school	3.61	1.22	153
Number of professional computer workshops attended	4.95	2.84	150
Number of computer types with which you have	2.34	1.00	153

The average computer teacher in Orange County appears to have had considerable experience in using the computer. Most appear to have taught in the field for several years as well. The amount of formal college instruction appears limited, although there is a range of experience, from those majoring in computer science and having worked in industry as computer programmers, to those who have had a minimum. It should be noted that the modal response in this category was zero (0) computer courses taken. This wide range in formal training appears to reflect the fact that there are no set standards for computer teachers as there are for teachers in other subject areas. The majority of respondents in this survey have had limited mathematics instruction in college, but the majority appear to have had fairly rigorous mathematical preparation in high school. It appears that most of these computer teachers have attended several professional computer workshops and inservices to expand their current computer knowledge (Modal response in this category was eight workshops attended). Finally, it can be seen that most teachers in this sample have had experience in using two or more types of personal computer.

Table 6
Background Information

Topic	Yes	No	N
Do you own a Personal Computer?	81.9%	18.1%	160
Do you teach computer literacy?	85.6%	14.4%	160
Do you teach computer programming?	45.3%	54.4%	159
Do you teach word processing?	93.8%	6.3%	160
Do you teach the use of spreadsheets?	35.6%	64.4%	160
Do you teach the use of data-bases?	60.4%	39.6%	159
Do you teach using CAI programs?	62.4%	36.9%	156
Do you give inservices for other teachers?	64.2%	35.8%	159
Did you actively pursue the job you currently have now?	64.6%	35.8%	158
Do you teach data processing?	20.8%	79.2%	159

The majority of computer teachers in Orange County own a personal computer. A similarly high percentage teach computer literacy. Less than fifty percent teach computer programming or the use of spreadsheets. The majority teach word processing. Over half the teachers surveyed teach the use of data-base programs, use CAI type programs, and give inservices to other teachers. It is interesting that only two thirds of these teachers actively pursued the positions they currently occupy. Finally, the survey indicates that the majority of computer teachers do not teach data processing.

Section II. Teacher Perceptions of Student Computer Use

The following data deals specifically with teacher perceptions of student computer use. This section was specifically intended to determine if teachers feel there are any diffferences between males and females in terms of computer use. The following table shows the results:

Table 7
Teacher Perceptions of Student Computer Use

Question	Mean	Std. Err.	Std. Dev.	N
Boys are more interested in the computer than girls	2.18	0.07	0.91	159
Boys have greater abilities on the computer than girls	1.62	0.05	0.65	157
Computer ads in magazines are male dominated	2.69	0.06	0.71	143
Computer ads in newspapers are male dominated	2.80	0.06	0.75	142
Society tends to socialize boys towards computer use more so than girls	2.59	0.06	0.73	154
Male & female students receive equal amounts of exposure to the computer during their primary school years	3.39	0.06	0.75	143
Male and female students receive equal amounts of exposure to the computer during their secondary school years.	2.96	0.07	0.77	133

These data show that computer teachers tend to disagree that boys are more interested in the computer than girls. They more strongly disagree that boys have greater abilities on the computer than girls. With regards to computer advertisements in newspapers and magazines, it seems that most teachers are slightly inclined to think that these ads are male dominated. The question of males being socialized towards computer use more than their female counterparts appears undecided, neither an affirmative nor a negative response appears to dominate. In the area of exposure to the computer, it seems that most teachers feel that males and females receive equal amounts of exposure to the machine. This agreement, however, is polarized to a lesser degree at the secondary level--in other words, computer teachers appear less certain that males and females receive equal exposure to the computer during their secondary school years.

Section III. Awareness Levels and Perceived Competencies in Educational Technology

The following section deals with the degree of expertise that computer teachers see in themselves. It is also desiged to determine what level of awareness these teachers have in the field of educational computer technology. The questions are designed to show how much knowledge current classroom teachers have in some of the rapidly developing areas of classroom technology. It should be noted at this point that responses to some of these measures of awareness may actually have been opinions rather than reflections of actual knowledge. An assumption is made, however, that the responses obtained are based upon the knowledge that the teacher may or may not have possessed.

The data indicates that the computer teachers surveyed strongly feel that the computer is effective in: a) Helping the learning disabled; b) addressing the issue of diversity; and c) being used to enhance the writing process. Teachers appeared to strongly agree that: 1) Computers are becoming more user friendly, 2) interactive video is a tool that can be used across many disciplines; 3) interactive video is a tool that can effectively enhance classroom presentations; 4) that the computer is useful to teachers in different fields--particularly English, Math, and Science; 5) if students do not receive training in technology in public shcools, they will be at a great disadvantage later in life; 6) the effectiveness of the computer as an instructional tool is limited by the teacher's knowledge of the software and its capabilities; and 7) teacher currently in the public school system are in need of greater amounts of training in the field of educational technology.

The teachers surveyed appear to agree (although less strongly) that: CAI provides improved levels of instruction; the computer promotes higher reasoning skills in students at all grade levels; the computer is effective in promoting and enhancing creativity; the computer allows the student ot make the greatest use of his/her strongest sensory perceptual mode; the computer can be effective in diagnosing student learning problems; the computer is moving towards the eventual processing of natural language; the computer can effectively teach foreign languages; the use of the computer in instruction results in greater academic; the computer can be effective in teaching by the Socratic Method; the use of word processing results in a higher quality of writing from students; computers are improving in their abilities to emulate human decision making; business are making greater use of computers to train employees; the quality of instructional software is continually improving; the effectiveness of the computer as an instructional tool is limited by the amount of exisiting available software; the ability of teachers to use technology is limited by the amount of hardware available to them; the effectiveness of the computer as an instructional tool is limited by the quality of existing instructional software; students using word processors tend to write greater amounts of text; and finally, students using word processing tend to edit their documents with greater frequency.

With the exception of the idea that the effectiveness of the computer as an instructional tool is limited by the amount of EXISITING educational software, the responses discussed above appear to indicate that the computer teachers surveyed have a considerable awareness of the benefits that the computer can provide as an educational tool. Whether this knowledge stems from reviewing literature wtihin the field, attending professional workshops and conferences, or from classroom experience and discussions with other colleagues would require more detailed questionning. It seems clear, however, that overall, these teachers possess a reasonable knowledge of the different strengths of the computer.

The teachers surveyed also indicated disagreement with several of the items presented on the survey. In this section, teachers appeared to disagree that 1) the computer will be able to process English sentences, thereby eliminating the need for structured programming; 2) the computer will eventually replace the classroom teacher; 3) PE teachers routinely use the computer to help manage their classes; 4) there are currently adequte numbers of computers in individual classrooms for teachers to use; 5) the effectiveness of the computer as an instructional tool is limited by current hardware capabilities; 6) tutorials are the most effective CAI types; 7) drill and practice programs are the most effective CAI software; 8) expert systems are the most effective types of CAI software; 9) administrators in the public school system are aware of the potential benefits that exist from implementing technology in education; and 10) computers teach the way that teachers do.

Table 8
Awareness Levels in Different Aspects of Educational Technology

Question	Mean	Std. Err.	Std. Dev.	N
The computer can be an effective tool in helping the learning disabled	3.74	0.04	0.50	160
The computer can be an effective tool in addressing the issue of diversity in schools	3.52	0.05	0.61	156
The computer can be effecitve in enhancing the writing process	3.81	0.04	0.44	160
Computer are becoming more user friendly	3.68	0.04	0.51	160
The computer is an effective aid for the physical education teacher	2.64	0.07	0.81	137
Interactive Video is a tool that can be effectively used across many disciplines	3.41	0.06	0.65	138
Interactive video can be an effective tool in individualizing instruction	3.33	0.05	0.62	135
Interactive video is a tool that can effectively enhance classroom presentations	3.52	0.05	0.57	135
The computer will be able to process English sentences, thereby eliminating the need for structured programming	2.15	0.07	0.78	133
CAI provides improved levels of instruction to students	3.00	0.06	0.69	151
The computer will eventually replace the classroom teacher	1.20	0.04	0.52	159
The computer promotes higher reasoning skills in high school students	2.96	0.06	0.71	139
The computer promotes higher reasoning skills in middle school students	2.94	0.06	0.73	141
The computer promotes higher reasoning skills in elementary students	3.00	0.06	0.78	152
The computer is an effective tool in promoting and enhancing creativity	3.24	0.05	0.63	156
The computer is capable of teaching creativity	2.40	0.08	0.97	154
The computer can be useful to math teachers	3.66	0.04	0.48	157
The computer can be useful to English Teachers	3.67	0.04	0.48	159
The computer can be useful to history teachers	3.61	0.04	0.50	159
The computer can be useful to science teachers	3.65	0.04	0.48	159
The computer can be useful to music teachers	3.36	0.05	0.66	157
The computer can be useful to art teachers	3.41	0.05	0.60	155

Responses to some of the items above, particularly the effectiveness of the computer as an instructional tool being limited by current hardware capabilities, expert systems being the most effective types of CAI software, and that the computer will eventually be able to process English sentences, appear to indicate a lack of awarness within these areas. Current hardware capabilites of microcomputers do limit the sophisitication of software that can be used; expert systems have been found to be extremely effective in providing high quality instruction; and current research in Artificial Intelligence does indicate that the computer will eventually be able to process natural language.

The computer teachers surveyed appeared undecided in the following areas: a) I am aware of the use of expert computer systems in the field of education; b) computers reduce the amount of time needed to train students; and c) simulations are the most effective types of CAI. These responses again, show that there are areas where knowledge is lacking. Expert systems are among the types of computer based instruction that are being actively researched currently. It is likely that techniques used in this field will be applied to microcomputer based instruction as hardware capabilities of such systems continues to improve. Research has shown that computers can significantly reduce the amount of time necessary for students to master learning materials. This has been particularly true of students in need of remediation (Gross, 1989).

In terms of perceived comptencies, teachers in this survey stated that they had: a) Used the computer as a tool in promoting writing skills; b) used the computer to promote higher level thinking skills in their students; and c) used the computer to help individualize instruction. They also stated that they felt qualified to teach word processing.

On the negative end, the data collected showed that individuals in this study had little knowledge of: 1) ICAI (Intelligent Computer Assisted Instruction); 2) interactive video technology; 3) use of the computer in working specifically with the learning disabled; 4) use of the computer with "At Risk" students; 5) use of the computer in diagnosing the problems that students have with specific subject matter; 6) computer programming; and 7) use of spreadsheets.

It would seem that there is a great deal of room for improvement, particularly in the areas of spreadsheet use, interactive video technology, and use of the computer in diagnosing learning difficulties. The other areas mentioned are more specialized, and would probably involve teachers who do specific work in those respective fields. It would seem desirable, however, that the average classroom computer teacher have some exposure to these areas, as these are the "experts" on computer technology at their respective campuses.

Table 9A
Awareness Levels in Different Aspects of Computer Technology

Question	Mean	Std. Error	Std. Dev.	N
The computer can be useful to social science teachers	3.61	0.04	0.50	158
The computer allows the student to make the greatest use of his/her strongest sensory/perceptual mode	3.08	0.05	0.64	155
The computer can be effective in diagnosing the problems students have in learning	2.98	0.05	0.58	153
Computers are moving towards the eventual processing of natural language	3.03	0.06	0.67	135
Computers can be used to effectively teach foreign languages	3.11	0.05	0.64	144
Use of the computer in instruction results in greater advancements in student performance	3.16	0.05	0.60	152
PE teachers routinely use computer to help manage their classes	1.98	0.07	0.82	121
There are currently adequate numbers of computers in individual classrooms for teachers to use	1.30	0.05	0.57	156
Computers can be effective in training students by the Socratic Method	3.13	0.05	0.58	141
I am aware of the use of expert computer systems in the field of education	2.61	0.07	0.81	143
The use of word processing results in a higher quality of writing from students	3.34	0.06	0.72	157
Computers are improving in their abiities to emulate human decision making	2.85	0.06	0.72	147
Computers can teach like teachers do	1.45	0.05	0.66	157
Businesses are making greater use of the computer in training employees	3.30	0.05	0.62	145
If students do not receive training in technology in public schools, they will be at a great disadvantage later in life	3.62	0.04	0.52	157
Computers reduce the amount of time needed to train students	2.50	0.06	0.78	147
The quality of instructional software is currently very high	2.52	0.04	0.52	156
The quality of instructional software is continually improving	3.32	0.04	0.52	157
The effectiveness of the computer as an instructional tool is limited by the amount of existing available instructional software	2.87	0.07	0.83	154

Table 9B
Awareness Levels in Different Aspects of Computer Technology

Question	Mean	Std. Error	Std. Dev.	N
The ability of teachers to use technology is limited by the amount of hardware available to them	3.12	0.07	0.83	154
The effectiveness of the computer as an instructional tool is limited by the quality of existing instructional software	2.83	0.06	0.79	155
The effectiveness of the computer as an instructional tool is limited by the teacher's knowledge of the software and its capabilities	3.40	0.05	0.61	156
Simulations are the most effective types of CAI	2.62	0.06	0.62	131
The effectiveness of the computer as an instructional tool is limited by current hardware capabilites	2.38	0.06	0.69	150
Tutorials are the most effective CAI types	2.21	0.05	0.58	134
Drill and practice programs are the most effective CAI software	2.02	0.06	0.66	137
Expert systems are the most effective types of CAI software	2.24	0.05	0.53	101
Teachers currently in the public school system are in need of greater amounts of training in the field of educational technology	3.60	0.05	0.56	156
Administrators in the public school system are aware of the potential benefits that exist from implementing technology in education.	2.39	0.07	0.82	157
The computer promotes a higher quality of writing in students	3.30	0.05	0.64	157
Students using word processors tend to write greater amounts of text	3.14	0.06	0.74	155
Students using word processing tend to edit their documents with greater frequency	3.22	0.05	0.66	157

Table 10
Perceived Competency Levels of Computer Teachers in Educational Technology

Question	Mean	Std. Error	Std. Dev.	N
I am proficient in the area of ICAI	2.35	0.02	0.97	144
I am knowledgeable in the field of Interactive Video	2.50	0.07	0.90	153
I have used the computer in working specifically with learning disabled students	2.45	0.08	1.02	150
I have used the computer as a tool in promoting writing skills in my students	3.26	0.06	0.76	156
I have used the computer specifically for the purpose of working with "At risk students	2.41	0.08	1.00	148
I have used the computer as a tool in diagnosing the problems that students have with specific subject matter	2.27	0.08	0.97	146
I have used the computer for the purpose of teaching higher level thinking skills	3.00	0.06	0.71	153
I have used the computer to help individualize instruction	3.30	0.06	0.71	156
I feel qualified to teach computer programming	2.61	0.08	1.04	158
I feel qualified to teach word processing	3.48	0.05	0.60	159
I feel qualified to teach the use of spreadsheets	2.73	0.08	1.05	157

Section IV
Satisfaction Levels of Computer Teachers

Question	Mean	Std. Error	Std. Dev.	N
I was "forced" to accept the job that I now have teaching computer	1.34	0.05	0.68	158
I enjoy teaching computer classes	3.72	0.04	0.45	159
I would prefer to teach classes other than computer classes	1.67	0.07	0.82	155
I teach computer classes because these are the only ones that are currently available to me	1.27	0.04	0.54	154

This final section appears to indicate that most of the teachers surveyed willingly accepted the positions they now have. The satisfaction level of these individuals with respect to teaching course load seems to be correspondingly high. The majority appear to be happy teaching computer courses, and do not have the desire to "branch" out into other subject areas. Finally, there seems to be little support for the idea that these teachers teach computer courses because they are the only ones available to them. Overall, this survey appears to indicate that most of the computer teachers in Orange County enjoy their jobs, and do not desire career changes at this time.

Inferential Statistics: Comparisons Between Males and Females

The following section compares male and female responses in the categories detailed previously. The inferential technique of Chi Square Analysis was used to compare males and females on nominal level variables, and t-test was used to compare males and females on interval level variables. Differences are considered significant if they go below the 0.05 level of probability. The following table shows the results of the Chi-Square analysis.

Results of Chi-Square Analysis

Question	Chi Sq.	Significance	Cramer's V
1	0.11	0.74	0.03
2	0.08	0.77	0.02
3	0.026	0.61	0.04
4	0.01	0.92	0.01
5	9.51	<0.01	0.25
6	2.22	0.13	0.12
7	0.43	0.51	0.05
8	3.72	0.05	0.16
9	0.16	0.69	0.03
10	1.76	0.18	0.11

1--Do you own a personal computer?
2--Do you teach computer literacy?
3--Do you teach computer programming?
4--Do you teach word processing?
5--Do you teach the use of spreadsheets?
6--Do you teach the use of data bases?
7--Do you teach using CAI programs?
8--Do you give inservice training for other teachers in your district?
9--Did you actively pursue the job you have teaching computes?
10--Do you teach data processing?

These data indicate that males and females differed significantly on two questions. Males appeared to teach the use of spreadsheets with greater frequency than females. Females, on the other hand, appeared to give inservice training for other teachers with greater frequency than males. Considering the number of questions on this survey, it is possible that the differences observed in terms of inservice training could be the result of a Type I error. It is unlikely, however, that the same would be true for the differences observed in teaching spreadsheets, as the significance level in that instance was below 0.01. No other significant differences appeared in the nominal level measures.

The technique of t-test was used to determine if there were any significant differences between males and females on interval level data. The following tables are separated into four sections: 1) General Information; 2) Teacher perceptions of student computer use; 3) Awareness levels and perceived competencies in educational technology; and 4) Job satisfaction levels of computer teachers.

According to the data collected, male computer teachers are more inclined to agree that boys have a greater interest in using the computer than girls. Female teachers, on the other hand, appear to feel more strongly that boys and girls receive equal amounts of exposure to the computer during their primary school years. It should be noted that both sexes agree that exposure is equal during this time. The strength of the agreement is what differs significantly (0.01 level of probability). No other significant differences between males and females in this general information section appear to exist.

Table A
t-test: Comparisons between Males and Females in Professional Preparation & Experience

Question	t - Value	Df	2 tail prob.	1 tail prob.
I	-0.53	154	0.59	N/A
II	0.87	157	N/A	>.20
III	-0.22	155	N/A	>.20
IV	-0.75	151	N/A	>.20
V	0.45	154	N/A	>.20
VI	2.05	157	N/A	<0.025
VII	2.61	137	N/A	<0.01
VIII	2.70	150	N/A	<0.01
IX	-0.80	147	N/A	>0.20

I	Age
II	Number of years using the computer
III	Years of experience teaching computers
IV	Number of college computer courses taken
V	Number of high school computer courses taken
VI	Number of computers with which you have experience
VII	Number of math courses you had in college
VIII	Number of math courses you had in high school
IX	Number of professional workshops you have attended

The data above indicate that males and females appear to have similar backgrounds in most of the general information categories. There is a significant difference in the number of computers with which males and females have experience. This data indicates that males tend to have experience with more computer types than females (0.025 significance level). Males and females also differ significantly in terms of mathematical preparation. In this area, males have significantly greater amounts of formal coursework at both the high school and college levels. These findings confirm the results of other studies, where males were found to pursue mathematical coursework with greater frequency than their female counterparts.

Table B
t-test--Teacher Perceptions of Computer Use

Question	t - Value	Df	2 tail prob.
A	2.57	156	<0.01
B	1.26	157	0.20
C	0.30	141	0.77
D	-0.56	140	0.57
E	0.61	151	0.54
F	-2.59	140	0.01
G	0.48	131	0.64

A -- Boys are more interested in the computer than girls
B -- Boys have greater abilities in using the computer than girls
C -- Computer ads in magazines are male dominated
D -- Computer ads in newspapers are male dominated
E -- Society tends to socialize boys towards computer use more so than girls
F -- Male and female students receive equal amounts of exposure to the computer during their primary school years
G -- Male and female students receive equal amounts of exposure to the computer during their secondary school years

Table C1
t - test--Awareness Levels about Educational Technology

Question	t - Value	Df	1 Tail Probability
1	-3.09	157	>.20
2	-1.76	153	>.20
3	-1.51	157	>.20
4	-1.24	157	>.20
6	1.39	134	>.20
7	0.02	135	>.20
8	1.17	132	>.20
9	0.14	132	>.20
10	0.48	131	>.20
11	-0.99	148	>.20
12	3.46	156	<0.01 *
13	-1.57	137	>.20
14	-1.89	138	>.20
15	-1.80	149	>.20
16	-0.13	153	>.20
17	0.77	150	>.20
18	-1.13	154	>.20
19	-1.03	156	>.20

1 -- The computer is effective in helping the learning disabled
2 -- The computer can be an effective tool in addressing the issue of diversity in schools
3 -- The computer can be effective in enhancing the writine process
4 -- Computers are becoming more user friendly
5 -- The computer is an effective aid for the physical education teacher
6 -- Interactive Video is a tool that can be effectively used across many disciplines
7 -- Interactive video can be an effective tool in individualizing instruction
8 -- Interactive video is a tool that can effectively enhance classsroom presentations
9 -- The computer will be able to process English sentences thereby eliminating the need for structured programming
10 -- Computer Assisted Instruction provides improved levels of instruction to students
11 -- The computer will eventually replace the classroom teacher
12 -- The computer promotes higher reasoning skills in high school students
13 -- The computer promotes higher reasoning skills in middle school students
14 -- The computer promotes higher reasoning skills in elementary school students
15 -- The computer is an effective tool in promoting and enhancing creativity
16 -- The computer is capable of teaching creativity
17 -- The computer can be useful to mathematics teachers
18 -- The computer can be useful to English teachers

Table C2
t - test--Awareness Levels

Question	t - Value	Df	1 tail probability
21	-1.74	156	>.20
22	-1.35	156	>.20
23	0.23	154	>.20
24	-0.21	152	>.20
25	-2.05	155	>.20
26	-1.53	152	>.20
27	-1.56	150	>.20
28	-0.04	133	>.20
29	-0.49	141	>.20
30	-1.46	149	>.20
31	-1.92	118	>.20
32	1.77	153	0.05 *
33	1.24	138	>.10
34	-1.27	140	>.20
35	-2.26	154	>.20
36	0.41	144	>.20
37	0.74	154	>.20
38	-1.09	142	>.20
39	-0.67	154	>.20
40	0.61	144	>.20

21 -- The computer can be useful to history teachers
22 -- The computer can be useful to science teachers
23 -- The computer can be useful to music teachers
24 -- The computer can be useful to art teachers
25 -- The computer can be useful to social science teachers
26 -- The computer allows the student to make the greatest use of his/her strongest sensory perceptual mode
27 -- The computer can be effective in diagnosing the problems that students have in learning
28 -- Computers are moving towards the eventual processing of natural language
29 -- Computers can be used to effectively teach foreign language
30 -- Use of the computer in instruction results in greater advancements in student performance overall
31 -- PE teachers routinely use computers to help manage their classes
32 -- There are currently adequate numbers of computers in individual classrooms for teachers to use
33 -- Computers canb be effective in training students using the Socratic Method
34 -- I am aware of the use of expert computer systems in the field of education
35 -- The use of wordprocessing results in a higher quality of writing from students
36 -- Computers are improving in their abilities to emulate human decision making skills
37 -- Computers can teach the way that teachers do
38 -- Businesses are making greater use of the computer in training employees
39 -- If students do not receive training in technology in public schools, they will be at a great disadvantage later in life
40 -- Computers reduce the amount of time necessary to train students

Table C3
t-test--Awareness Levels About Educational Technology

Question	t - Value	Df	1 tail probability
41	-0.71	153	>.20
42	-1.27	154	>.20
43	0.63	152	>.20
44	-0.28	153	>.20
45	1.29	152	>.10
46	0.96	153	>.20
47	0.63	128	>.20
48	0.31	148	>.20
49	3.24	131	<0.01 *
50	1.48	134	<.10
51	-0.76	98	>.20
52	-0.62	153	>.20
53	-0.13	154	>.20
54	-1.19	154	>.20
55	-1.23	152	>.20

41 -- The quality of instructional software is currently very high
42 -- The quality of instructional software is continually improving
43 -- The effectiveness of the computer as an instructional tool is limited by the amount of existing available instructional software
44 -- The ability of teachers to use technology is limited by the amount of hardware available to them
45 -- The effectiveness of the computer as an instructional tool is limited by the quality of existing instructional software
46 -- The effectiveness of the computer as an instructional tool is limited by the teacher's knowledge of the software and its capabilities
47 -- Simulations are the most effective types of CAI
48 -- The effectiveness of the computer as an instructional tool is limited by current hardware capabilites
49 -- Tutorials are the most effective type of CAI software
50 -- Drill and practice programs are the most effective types of CAI software
51 -- Expert systems are the most effective types of CAI software
52 -- Teachers currently in the public school system are in need of greater amounts of training in the field of Educational Technology
53 -- Administrators in the public school system are aware of the potential benefits that exist from implementing technology in education
54 -- The computer promotes a higher quality of writing in students
55 -- Students using word processors tend to write greater amounts of text

Table C4
t-test--Awareness Levels and Perceived Competencies in Educational Technology

Question	t - Value	Df	1 Tail Probability
56	-1.21	154	>.20
57	-0.01	147	>.20
58	-2.19	153	>.20
59	1.25	145	>.20
60	0.02	143	>.20
61	-0.75	150	>.20
62	0.23	153	>.20
63	1.96	155	<.025 *
64	-0.24	156	>.20
65	2.17	154	<.05 *
66	-1.07	143	>.20
67	0.79	150	>.20

56 -- Students using word processing tend to edit their documents with greater frequency
57 -- I have used the computer in working specifically with learning disabled students
58 -- I have used the computer as a tool in promoting writing skills in my students
59 -- I have used tehc omputer specifically for the purpose of working with "At Risk" students
60 -- I have used the computer as a tool in diagnosing the problems that students have with specific subject matter
61 -- I have used the computer specifically for the purpose of teaching higher level thinking skills in my students
62 -- I have used the computer to help individualize instruction
63 -- I feel qualified to teach computer programming
64 -- I feel qualified to teach word processing
65 -- I feel qualified to teach the use of spreadsheets
66 -- I am proficient in the area of ICAI (Intelligent Computer Assisted Instruction)
67 -- I am knowledgeable in the field of interactive video

Males were more likely to agree that the computer is useful to high school teachers. Significant differences were found on this question (1 tail probability <0.01). Males were less likely to disagree that there are adequate numbers of computers in the classroom than females (1 tail probability <0.01).

Other significant differences were found to exist in the belief that tutorials are the most effective type of CAI. Here, males were more inclined to adhere to this idea (1 - tail probability < 0.01). Males appeared to have greater proficiency (self confidence) in the field of computer programming (1 tail prob. <0.025). Finally, males tended to believe they were qualified to teach the use of spreadsheet programs with greater frequency than their female counterparts (1 -tail probability <0.05). This ties in with the data yielded by the Chi Square Analysis, where males were found to be more likely to teach the use of spreadsheets than females. Due to the levels of the 1-tailed probabilities obtained in this section, it is unlikely that these differences are the results of Type I errors except for the question dealing with spreadsheet competency. No other differences were found to exist at or below the 0.05 significance level.

Table D
Satisfactions Levels of Computer Teachers

Question	t - Value	Df	1tail prob.	2 tail prob.
i	2.49	155	N/A	<0.01
ii	-1.24	156	>.20	N/A
iii	1.89	152	<0.05	N/A
iv	0.96	151	>.20	N/A

i I was "forced" to accept the job that I have teaching computers
ii I enjoy teaching computer classes
iii I would prefer to teach classes other than computer classes
iv I teach computer classes because these are the only ones available to me

This final section indicates that males and females differ signicantly in the area of being "forced to accept the jobs" that they currently have. It appears that males were more likely to have been "coerced" into accepting their current positions. Comments provided by some of the respondents did in fact indicate that these individuals were given computer course loads without consultation on the matter. Although these occurrences were generally infrequent, they did occur more often in the cases of male teachers than female teachers. Males also appeared to have a greater desire to teach other courses when compared with females. Although they did not express dissatisfaction with their positions, this statistic did make it appear that they are less satisfied in their current positions than their female counterparts. These findings are notably different from the initial hyptheses of this study.

It should be mentioned that primary (K-6) and secondary (7-12) teachers were compared statistically on measures of background, awareness, competency, and attitudes. These comparisons revealed no consistent differences.

The statistical findings will be reviewed and discussed in the concluding chapter.

Chapter V: Discussion and Conclusion

The intent of this study was to answer research questions in five different areas. The questions were as follows:

1) How do male and female computer teachers compare in terms of professional preparation and experience?
2) What are the demographics of computer teachers currently in the classroom?
3) How do computer teachers perceive their male and female students?
4) What levels of awareness, proficiency and expertise currently exist in the classroom among computer teachers?
5) What are the attitudes of computer teachers in the field?

I. Backgrounds--The results of this study indicated that male and female teachers have very similar backgrounds overall. This included the amount of formal college computer training. Significant differences did exist in the areas of mathematical backgrounds--both high school and college. As anticipated, males had significantly more formal training in mathematics. All other measures, such as years of experience using the computer, years of experience teaching computers, and the number of professional workshops attended, show that males and females do not differ. This was contrary to the initial hypothesis, which was that males should have significantly greater amounts of formal training overall. This hypothesis was based upon the literature which suggested that males generally have greater amounts of training and experience in mathematically oriented fields. The fact that greater differences were not observed was unexpected.

It should be noted that males as a general rule do not choose the teaching profession with the same frequency as their female counterparts (Astin, 1985). Those males who do select the teaching profession may tend to have backgrounds and attitudes that are more in line with the overall norms of the profession, rather than the gender. This explanation may at least in part, account for the similarities that were observed.

In the area of formal preparation, some disturbing results were revealed. Although the mean response on this survey for the item concerning the number of college computer courses taken was 3.42, the modal response was zero (0). The range of formal training was from no courses taken, all the way through bachelors and masters degrees in computer science and educational computer technology. These results are almost certainly due to the lack of standards that currently exist in the computer field. There is no "computer credential" that is required for those individuals teaching computers in primary or secondary school. Because of this, essentially any individual (even those who are not qualified) may teach computer courses. The immediate problem that can result from a lack of standardization is the one that has been observed in this study--essentially widely varying amounts of formal training. Teachers in other subject areas are required to take specific course-work to receive credentials in their respective fields. Guidelines and expectations for those subject areas are therefore, more uniform. The basic premise is to insure that all students receive instruction from teachers who meet minimum competency levels. This, unfortunately, is not the case in the computer field at this time.

One can conclude that students receiving instruction from teachers whose backgrounds vary as widely as they do in this study, probably do not receive the same quality of instruction overall. This is a negative effect resulting from a lack of standardization.

II. Demographics--On the issue of teacher demographics, there were again, some unanticipated results. The initial hypothesis was that males would be over-represented in the field of teaching computers. This hypothesis was based upon the fact that males tend to select careers that are more mathematically oriented. This has included subject areas such as science, engineering, and those that are computer based. The results of this study indicated that females outnumbered males by a ratio of about 2.4 : 1. The differences were highest at the elementary level. However , females continued to dominate in terms of overall percentages through secondary school. This finding demonstrated that there are a great number of female role models in the classroom--actually teaching computers. Therefore, the average student is likely to see women in this field--contrary to what was believed initially. It appears that there should be less concern that school aged children--particularly females--will not receive the proper signals regarding computer use due to a lack of female representation.

It should be mentioned that there was concern that females might be more likely to respond to surveys than males--thereby distorting actual percentages. For this reason, the numbers obtained in this survey were compared to numbers obtained on teachers for the state of California in the 1980 U.S. Census. The census data showed that females outnumbered males overall by a ratio of 2.23 : 1. This ratio is very close to the one obtained in this study. A second check involved a random sampling by telephone of 20 computer teachers who did not respond to the survey--to see if they were male or female. Results of this check showed that 14 of the 20 teachers surveyed were female. From this information, it can be concluded that the numbers obtained in this study are probably quite representative and that the gender distribution of computer teachers is quite similar to that of teachers overall. Thus, it appears that females do outnumber their male counter-parts in this topic area.

Another aspect of demographics concerned ethnicity. It was anticipated that Caucasians would dominate this field. The degree to which they dominated, however, was not expected. Data in this survey showed that 9.1 out of every 10 teachers were white. Hispanics rated second in overall numbers--5.7%. This group was followed by Asians and American Indians, who each had the same levels of representation by percentage (1.3% each). The there were NO black respondents in this sample. Considering that blacks represent about seven percent (7.0%) of the state population, it was surprising to find that there was not a single black computer teacher in this survey. The percentage of black teachers in Orange County overall, however was only one percent. With this in mind, the results obtained in this study appear more reasonable. It should be mentioned that the ethnic breakdown of teachers in this study actually matched up fairly well with the ethnic breakdown of teachers in Orange County as a whole. However, these percentages do not match the overall demographics of the county. In other words, the ethnicity of teachers in the classroom is not representative of the students that they teach.

III. Teacher Perceptions of Computer Use--Results in this section show that teachers generally perceive males and females to have equal levels of interest and ability in using computers. Teachers in this field also seem to feel that males and females receive equal amounts of exposure to the computer in both their primary and secondary school years. It should be noted that male teachers had a greater tendency to think that boys were more interested in the use of the computer than girls. Male teachers were also less likely to strongly agree that male and female students received equal amounts of exposure to the computer during their secondary school years. It should also be mentioned that overall inclinations are not different between the sexes. The differences exist in the strength of their convictions.

The results of this section were contrary to initial hypotheses. It was anticipated that teachers would perceive boys as being more interested and competent in the areas of computer use. Based on this, it was also expected that males would have greater exposure to the computer when compared to girls (both during primary and secondary school years). It should be remembered, however, that other studies have indicated that males and females do not differ significantly in terms of overall attitudes. It has been shown that the theme of an application program under use can have an effect on interest--girls preferring certain themes, and boys preferring others. Generally speaking, however, males and females both tend to find the computer an intriguing tool. Exposure to the computer during school time is probably equal for both males and females. This is how teachers probably interpreted the question. Given the information provided, it would be interesting to see what teacher perceptions are for student computer use outside of formal class time. Do males and females receive equal amounts of exposure to the computer at home? Do they use the computer with equal frequency outside of class? The answers to these questions might yield results that were different from the ones obtained in this study.

Teachers were also asked about their perceptions of computer ads in magazines and newspapers--specifically whether or not these ads tend to be male dominated. Teachers appeared to be undecided on these issues--neither affirmative nor negative responses dominated on these questions. The broader question of whether society tends to socialize boys towards computer use more so than girls, yielded similar results. It can be stated that these responses tend to indicate a lack of awareness on these matters--research has shown that computer advertisements do tend to re-inforce stereotypes of male domination in the computer field. Different periodicals vary in the degrees to which they portray these stereotypes--systems magazines being the worst offenders, and educational magazines showing the least amount of bias. The point is that stereotypes are present in all periodical types regardless of theme. Teachers should be sensitive to references and other sources of information in the environment that present this type of bias, and take steps to diffuse messages that can have a negative influence on specific groups.

IV. Awareness and Competency Levels--It should be mentioned that some of the measures of awareness used in this study could also be interpreted as opinions. There may be those who would argue that what has been stated as "high" or "low" levels of awareness are actually the personal opinions of the teachers responding. In this regard, some assumptions have been made on the part of the author. Measures of competency, on the other hand, are based upon actual experience (self reported) with regard to specific computer applications. Care has been exercised in distinguishing "awareness measures" from "competency measures."

On the issue of overall awareness, computer teachers in this survey appeared to have a strong command of many of the capabilities provided by the microcomputer. The teachers responding to the survey knew about how the computer was useful as an aid in managing instruction, promoting writing skills, providing improved levels of instruction, and promoting higher level thinking skills. Teachers also appeared knowledgeable in the areas of: computer literacy (specifically the importance of this topic); computer use in business (for training employees); and computer limitations (both software and practical limitations). Much of this knowledge may have been obtained from professional workshops and peer interaction in addition to personal experience. Results of this survey showed that most computer teachers have attended several professional workshops to expand their computer proficiency.

On the negative end, the data collected does showed that improvements can be made in several areas. Teachers showed little awareness of expert systems and artificial intelligence (ICAI)--fields that show a great deal of promise in promoting the quality of education. Knowledge of computer hardware could also be improved. Awareness of the benefits that CAI (computer assisted instruction) can provide--specifically how the computer can reduce the amount of time needed to train students, and how the computer can help to diagnose learning difficulties--should be more widespread. Teachers should also have more knowledge in the fields of interactive video, and spreadsheet use.

The use of expert systems and artificial intelligence in education is likely to expand as the hardware capabilities of computers continue to grow. Teachers responding to this issue seemed to have little knowledge of its importance. Moreover, as computer use becomes wide-spread in education, it is likely that this tool will be used to provide quality instruction to individuals in need of further assistance. Because the computer reduces the amount of time it takes to convey material, students using instruction of this sort may be able to advance beyond normal expectations. Teachers can also employ the computer to help provide students in need of remediation with the means to "catch up." By providing diagnostic capabilities, it is possible that the computer will be able to allow teachers to tailor lessons designed to meet specific needs. Interactive video has been shown to be a very effective instructional medium. The technology to use this as an effective tool in the classroom exists currently.

None of these innovations can be employed, however, if teachers lack the knowledge in these areas. It is not possible to search for software with expert system capabilities if one does not know what an expert system is. The same applies to the other areas of educational technology. What is unfortunate about this situation is that computer teachers in the classroom also act as resident experts for other teachers. The knowledge they possess is passed on--but only that which they possess. The more knowledgeable the teacher, the more valuable he/she is as a resource.

In the area of perceived competency levels in the field of educational technology, this study showed that improvements could be made in: 1) Intelligent Computer Assisted Instruction; 2) Interactive video technology; 3) Use of the computer in working specifically with the learning disabled; 4) Use of the computer with "At Risk" students; 5) Use of the computer in diagnosing the problems that students have with specific subject matter; 6) Computer programming; and 7) Use of spreadsheets. Teachers in this study reported low levels of ability in each of the areas mentioned.

It should be noted that a large percentage of the classroom teachers in this study obtained their teaching credentials prior to the implementation of California's computer literacy mandate. This can be seen from the fact that there are numerous teachers with no formal college computer coursework--as mentioned earlier. The possibility exists that computer teachers entering the classroom subsequent to the state mandate will have a better overall knowledge of the topics that have been discussed. It would seem, however, that other measures will be necessary to keep teachers up to date on the latest developments in educational technology--as this is one of the most rapidly developing fields at this time.

Sex differences in this section revealed the following: 1) Males tended to believe that the computer promotes higher reasoning skills in high school students; 2) Males more strongly agree that tutorials are the most effective types of CAI software; 3) Males tend to feel more qualified to teach computer programming; and 4) Males feel more qualified to teach the use of spreadsheets. It is possible that question 4 is due to a Type I error.

Items 1 and 2, although statistically significant, do not appear to be of any real importance otherwise. Although the strength of the inclinations on these items differed between males and females, the orientation of the inclinations were identical.

Items 3 and 4 can be explained on the basis of mathematical orientation. Descriptive statistics obtained earlier showed that males tended to have more extensive backgrounds in terms of mathematical training. Programming and spreadsheet use are logical extensions of mathematics. Here, males seem to be making use of the computer as a mathematical tool. Females on the other hand, seem to compensate by using the computer as a verbal tool--for text editing, manipulation, and word processing in general.

Except for the differences highlighted, males and females did not differ significantly on any other aspects of awareness, or competency levels. Contrary to the initial hypothesis, males and females appear to have similar levels of awareness and expertise within the field. This may be accounted for by the idea that although males tend to pursue mathematically oriented careers with greater frequency than females, these same individuals tend not to enter teaching. Males who do enter the teaching profession may tend to have backgrounds that are more similar to their female counterparts.

V. Satisfaction Levels of Computer Teachers--The results of this section show that computer teachers appear to be very satisfied with their jobs. Of the teachers surveyed, there was no one who expressed dissatisfaction with his/her job. This in itself was an interesting finding, as some dissatisfaction might be expected from such a large group. More importantly, satisfaction levels appear to be the same for both male and female teachers (contrary to the initial hypothesis, where it was anticipated that males would have higher satisfaction levels). Significant differences existed on the issue of "being forced" to accept the job that they currently have teaching computers. Although males and females disagreed with this item overall, there was a greater tendency for males to have been coerced into their positions when compared with females. Reasons for this particular finding are uncertain. It is possible that principals may be more willing to force men into undesired situations as opposed to women. Analysis beyond this level would require more information. This finding could possibly serve as the basis for a more detailed study in this area. Differences were also observed on the issue of preferring to teach classes other than computers. Males tended to be more inclined to teach other classes when compared to their female counterparts. These two findings seem to indicate higher degrees of dis-satisfaction with the job on the part of males. This finding is inconsistent with the initial hypothesis of the study .

Summary

This study has essentially yielded findings that are contrary to most of the initial hypotheses that were stipulated. The findings can be summarized as follows:

1) Contrary to the initial hypothesis, male and female computer teachers tended to have similar levels of professional training and experience overall. This was opposite to what has been suggested in the literature--namely that males generally select course-loads in mathematically oriented fields (including computer courses) with greater frequency than females.

2) Contrary to the initial hypothesis, female computer teachers out-numbered their male counterparts by a wide margin. This finding was inconsistent with the literature, which tended to indicate that the reverse should be true. According to the numbers obtained from the 1980 U.S. Census, females dominated the teaching profession by percentage overall. This trend was reflected in the numbers obtained for this study. Similarly, the data for this study matched up closely with gender percentages for teachers in Orange County overall.

On the issue of ethnicity, again, the numbers obtained for this study matched up well with ethnic percentages for teachers in Orange County. It was surprising that there were no black respondents in the sample. However, the percentage of black teachers in Orange County in general is quite low (1%), so the fact that no blacks appeared in this sample may be a reflection of their low representation in the county overall. The percentage of hispanic computer teachers, although matching up well with overall percentages of teachers for the county, did not reflect the general demographics of the county. From this standpoint, it might be stated that the percentage of hispanic teachers is not representative of the general student population in Orange County Schools.

3) Contrary to initial hypotheses, computer teachers perceived their male and female students to have similar levels of interest and expertise using the computer. This finding was less surprising if viewed from the standpoint that other studies have indicated that both male and female computer

students tend to have interest in using the device. Theme of the application program under use appears to be the significant factor in affecting student interest.

4) Contrary to initial hypotheses, male and female computer teachers were found to have similar levels of awareness and levels of expertise within the field of educational technology. This may again be accounted for by the fact that males entering the teaching profession are "unusual" from the standpoint that most males tend to pursue other careers. Those who do enter teaching may tend to have similar backgrounds to their female counterparts.

   This section also revealed that improvements can be made in terms of overall awareness and preparation in the topic of educational technology. The data in this study show in particular that the amounts of formal computer training received by computer teachers in the classroom varies widely. Some teachers have degrees in computer science and data processing, where others have had no formal computer training at all. The most disturbing statistic was that the modal response for the number of computer courses taken by teachers was zero (0).

5) Contrary to the initial hypothesis, male and female computer teachers tended to have similar attitudes towards their jobs. Results in this section indicated that NO respondents were dissatisfied with their current occupations. This was unexpected, considering the overall size of the sample.

Recommendations

Since males and females in computer education appear to have similar backgrounds overall, it does not seem necessary to focus special attention on either gender. There are, however, areas of deficiency in educational computer technology that should be addressed.

If matters of policy were to be established on the basis of this study, it might be recommended that studies be undertaken to determine if the low percentages of males in teaching overall are having a negative impact on education. It seems clear that males are under-represented in the classroom. This could be a reflection of predjudices and resulting stereotypes towards the teaching profession that are unjustified.

Similar recommendations could be made regarding minorities in education. All ethnic minority groups, but particularly blacks and hispanics, appear to be under-represented in schools when numbers in this study are compared with state and county percentages. The existence of appropriate ethnic role models can possibly have a powerful influence on the career choices students make. This can also affect the self images of these students. The promotion of greater balance with regard to ethnicity might also provide the additional advantage of allowing schools to more effectively address issues of diversity--such as bilingualism.

It would appear that structured guidelines are necessary to establish standards for computer teachers. This study supports the argument for establishment of certification or credentialing for computer teachers. Without standards, it is unlikely that students receiving computer instruction in different areas will be obtaining the same quality of instruction overall. It can be surmised that the knowledge bases of these teachers must vary over a wide range. Continuing the policy of "no standards" will perpetuate the inequities that must certainly exist within the system currently. Although the establishment of standards will not guarantee perfect equality, it is a movement towards the provision of

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minimum competency levels within the field. Since specific course requirements exist for other subject areas, it seems reasonable to include the computer field as well.

Minimum standards for teachers should probably include training in the areas of interactive video, telecommunications, computer assisted instruction, intelligent computer assisted instruction, use of basic application programs (word processing, spreadsheet, and database), and use of the computer with special groups--such as the Learning Disabled and Physically Handicapped. Instruction should also be given in the area of how to incorporate CAI into established curriculums. These are areas where many teachers in this study showed deficiencies. Training could also be provided in the area of computer programming. Using programming languages such as Logo to help build the cognitive skills of students might be emphasized, particularly in elementary school curriculums. Use of programming to build logic and reasoning skills in students at all levels should be emphasized, which can have the additional benefits of increasing student familiarity with the computer's capabilities and building self confidence in using the machine. Teachers should also be trained in the use of authoring languages (for example, Hypercard). These user friendly programming languages can serve as excellent utilities for creating effective classroom presentations. Finally, teachers should be trained in the use of the different types of computer hardware and peripheral devices that are commonly used in school settings. This is a broad area that is continually changing. As computer teachers serve as resident experts at their respective school sites, this type of exposure seems crucial.

To insure competency levels of teachers currently in the classroom, mandatory attendance at computer workshops covering the areas discussed above might be one solution. Requiring teachers to take college courses in educational technology if they are to continue teaching in the field of computer education might be another (this might actually provide more uniform levels of exposure to technology than the use of workshops). The primary goal would be to provide training to computer teachers in areas where they are currently deficient. It probably would help to require those teachers currently in the classroom to receive regular course-work in educational technology if they are to continue in their fields. Because the field of educational technology is such a rapidly changing and expanding one, it seems even more imperative that course requirements be stringent. Keeping up with changes and new developments in this field is much easier if one is channeled into environments where this can easily take place. The ultimate benefactors will be the students receiving instruction in the classroom.

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Appendix A

Computer Survey

Care of the Faculty in Education, Harper Hall
The Claremont Graduate School: Attention Russell Okinaka

Section I: General Information

1. What is your age? a) Below 22 b) 23 - 30 c) 31 - 40 d) 41 - 50 e) Over 50

2. Sex? M ______ F ______

3. Ethnicity: a) Caucasian b) Asian-American c) Afro-American d) Hispanic e) Pacific Islander

f) Other (Please Specify) ____________________

4. Teaching Grade Level? K - 6 ________ 7 - 8 ________ 9 - 12 ________

5. Number of years using the computer? ________

6. Years of experience teaching computers? ________

7. Number of college computer courses taken? ________

8. Number of high school computer courses taken? ________

9. Do you own a personal computer ? Yes ________ No ________

10. Do you teach basic computer literacy? Yes ________ No ________

11. Do you teach computer programming? Yes ________ No ________

12. Check all of the computers with which you have experience:

a) IBM PC ____ b) Apple II series ____ c) Apple MacIntosh ____

d) Commodore 64/128 ____ e) Commodore Amiga ____

f) Others (Please Specify) ____

13. Do you teach word processing? Yes ________ No ________

14. Do you teach the use of spread sheets? Yes ________ No ________

15. Do you teach the use of data bases? Yes ________ No ________

16. Do you teach using Computer Assisted Instruction (CAI) programs?

Yes ________ No ________

17. Do you give inservice training for other teachers in your district?

Yes ________ No ________

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18. Did you actively pursue the job that you have teaching computers?

Yes ________ No ________

19. Number of math courses you had in college? ________

20. Number of math courses you had in high school? ________

21. Do you teach computer business applications/data processing?

Yes ________ No ________

22. Number of professional computer workshops you have attended ________

In the following sections:

4 = Strongly Agree; 3 = Agree; 2 = Disagree; and 1 = Strongly Disagree

Section II: Teacher Perceptions of Student Computer Use

	4	3	2	1
23. Boys are more interested in the computer than girls .	☐	☐	☐	☐
24. Boys have greater abilities in using the computer than girls.	☐	☐	☐	☐
25. Computer ads in magazines are male dominated .	☐	☐	☐	☐
26. Computer ads in newspapers are male dominated .	☐	☐	☐	☐
27. Society tends to socialize boys towards computer use more so than girls.	☐	☐	☐	☐
28. Male and female students receive equal amounts of exposure to the computer during their primary school years.	☐	☐	☐	☐
29. Male and female students receive equal amounts of exposure to the computer during their secondary school years.	☐	☐	☐	☐

Section III: Awareness Levels and Perceived Competencies in Educational Technology

	4	3	2	1
30. The computer can be an effective tool in helping the learning disabled.	☐	☐	☐	☐
31. The computer can be an effective tool in addressing the issue of diversity in schools.	☐	☐	☐	☐

4 = Strongly Agree; 3 = Agree; 2 = Disagree; and 1 = Strongly Disagree

	4	3	2	1
32. The computer can be effective in enhancing the writing process.	☐	☐	☐	☐
33. Computer are becoming more user friendly.	☐	☐	☐	☐
34. I am proficient in the area of ICAI (Intelligent Computer assisted instruction).	☐	☐	☐	☐
35.The computer is an effective aid for the physical education teacher.	☐	☐	☐	☐
36. I am knowledgeable in the field of Interactive Video .	☐	☐	☐	☐
37. Interactive Video is a tool that can be effectively used across many disciplines .	☐	☐	☐	☐
38. Interactive video can be an effective tool in individualizing instruction.	☐	☐	☐	☐
39. Interactive video is a tool that can effectively enhance classroom presentations.	☐	☐	☐	☐
40. The computer will be able to process English sentences thereby eliminating the need for structured programming .	☐	☐	☐	☐
41. Computer Assisted Instruction provides improved levels of instruction to students.	☐	☐	☐	☐
42. The computer will eventually replace the classroom teacher.	☐	☐	☐	☐
43. The computer pr.omotes higher reasoning skills in high school students.	☐	☐	☐	☐
44. The computer promotes higher reasoning skills in middle school students.	☐	☐	☐	☐
45. The computer promotes higher reasoning skills in elementary school students.	☐	☐	☐	☐
46. The computer is an effective tool in promoting and enhancing creativity.	☐	☐	☐	☐
47. The computer is capable of teaching creativity.	☐	☐	☐	☐
48 The computer can be useful to mathematics teachers.	☐	☐	☐	☐
49. The computer can be useful to English teachers .	☐	☐	☐	☐
50. The computer can be useful to history teachers .	☐	☐	☐	☐

4 = Strongly Agree; 3 = Agree; 2 = Disagree; and 1 = Strongly Disagree

51. The computer can be useful to science teachers . ☐ ☐ ☐ ☐

52. The computer can be useful to music teachers . ☐ ☐ ☐ ☐

53. The computer can be useful to art teachers . ☐ ☐ ☐ ☐

54. The computer can be useful to social studies teachers . ☐ ☐ ☐ ☐

55. The computer allows the student to make the greatest use of his/her strongest sensory perceptual mode (i.e. audio learners, visual learners, etc.). ☐ ☐ ☐ ☐

56. The computer can be effective in diagnosing the problems that students have in learning. ☐ ☐ ☐ ☐

57. Computers are moving towards the eventual processing of natural language. ☐ ☐ ☐ ☐

58. Computers can be used to effectively teach foreign languages. ☐ ☐ ☐ ☐

59. Use of the computer in instruction results in greater advancements in students performance overall . ☐ ☐ ☐ ☐

60. PE teachers routinely use computers to help manage their classes. ☐ ☐ ☐ ☐

61. There are currently adequate numbers of computers in individual classrooms for teachers to use. ☐ ☐ ☐ ☐

62. Computers can be effective in training students using the Socratic Method (Discovery Learning). ☐ ☐ ☐ ☐

63. I am aware of the use of expert computer systems in the field of education. ☐ ☐ ☐ ☐

64. The use of wordprocessing results in a higher quality of writing from students. ☐ ☐ ☐ ☐

65. Computers are improving in their abilities to emulate human decision making skills. ☐ ☐ ☐ ☐

66. Computers can teach the way that teachers do. . ☐ ☐ ☐ ☐

67. Businesses are making greater use of the computer in training employees. ☐ ☐ ☐ ☐

68. If students do not receive training in technology in public schools , they will be at a great disadvantage later in life. ☐ ☐ ☐ ☐

4 = Strongly Agree; 3 = Agree; 2 = Disagree; and 1 = Strongly Disagree

	4	3	2	1
69. Computers reduce the amount of time necessary to train students.	☐	☐	☐	☐
70. The quality of instructional software is currently very high.	☐	☐	☐	☐
71. The quality of instructional software is continually improving.	☐	☐	☐	☐
72. The effectiveness of the computer as an instructional tool is limited by the amount of existing available instructional software.	☐	☐	☐	☐
73. The ability of teachers to use technology is limited by the amount of hardware available to them.	☐	☐	☐	☐
74. The effectiveness of the computer as an instructional tool is limited by the quality of existing instructional software.	☐	☐	☐	☐
75. The effectiveness of the computer as an instructional tool is limited by the teacher's knowledge of the software and its capabilities.	☐	☐	☐	☐
76. Simulations are the most effective types of CAI software.	☐	☐	☐	☐
77. The effectiveness of the computer as an instructional tool is limited by current hardware capabilities (memory restrictions, processing speed, etc).	☐	☐	☐	☐
78. Tutorials are the most effective type of CAI software .	☐	☐	☐	☐
79. Drill and practice programs are the most effective types of CAI software.	☐	☐	☐	☐
80. Expert systems are the most effective types of CAI software.	☐	☐	☐	☐
81. Teachers currently in the public school system are in need of greater amounts of training in the field of Educational Technology.	☐	☐	☐	☐
82. Administrators in the public school system are aware of the potential benefits that exist from implmenting technology in education.	☐	☐	☐	☐
83. The computer promotes a higher quality of writing in students.	☐	☐	☐	☐

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4 = Strongly Agree; 3 = Agree; 2 = Disagree; and 1 = Strongly Disagree

84. Students using word processors tend to write greater amounts of text.	☐	☐	☐	☐
85. Students using word processing tend to edit their their documents with greater frequency.	☐	☐	☐	☐
86. I have used the computer in working specifically with learning disabled students.	☐	☐	☐	☐
87. I have used the computer as a tool in promoting writing skills in my students.	☐	☐	☐	☐
88. I have used the computer specifically for the purpose of working with "At Risk Students" (Students in danger of failing and/or dropping out of school).	☐	☐	☐	☐
89. I have used the computer as a tool in diagnosing the the problems that students have with specific subject matter.	☐	☐	☐	☐
90. I have used the computer specifically for the purpose of teaching higher level thinking skills in my students.	☐	☐	☐	☐
91. I have used the computer to help individualize instruction.	☐	☐	☐	☐
92. I feel qualified to teach computer programming .	☐	☐	☐	☐
93. I feel qualified to teach word processing .	☐	☐	☐	☐
94. I feel qualified to teach the use of spreadsheets .	☐	☐	☐	☐

Section IV. Satisfaction Levels of Computer Teachers

	4	3	2	1
95. I was "forced" to accept the job that I have teaching computers.	☐	☐	☐	☐
96. I enjoy teaching computer classes .	☐	☐	☐	☐
97. I would prefer to teach classes other than computer classes.	☐	☐	☐	☐
98. I teach computer classes because these are the only ones that care currently available to me .	☐	☐	☐	☐

Additional Comments: ____

Appendix B

Russell Okinaka
c/o The Claremont Graduate School
2848 Hollow Oak Ct.
Chino Hills, CA 91709

Dear Computer Teacher,

I am a student in the Ph.D. program at the Claremont Graduate School, and am currently conducting research for my dissertation. I am interested in studying educators who are directly involved with the use of technology in education. My study is intended to obtain both descriptive and inferential statistics in this area. Because the use of technology in education is such a new field, relatively speaking, there is a great deal of information that is of special interest, such as the demographics of teachers within the field, attitudes towards computer use, etc. Information of this sort can be useful for establishing policy at various levels. For instance, requirements for teacher candidates in schools of education can be affected by the findings of such studies.

Your participation in this study is completely voluntary, but would be greatly appreciated. The greater the size of the survey sample, the greater the validity of the results.

I am aware of the many demands that teachers have on their time, but would like to request that you devote a few minutes to complete the enclosed questionnaire. A stamped return envelope has been enclosed for your convenience.

Thank you very much for your consideration.

Sincerely,

Russell Okinaka
Claremont Graduate School

Appendix C

Dear Computer Teacher,

Approximately 3 weeks ago you received a questionnaire that is being used to obtain data for a dissertation. This post-card is a reminder that your participation in this study would be greatly appreciated. I would like to request that you take a few minutes to complete the questionnaire, and return it in the stamped envelope that has been previously provided. If you have already mailed the questionnaire, please disregard this postcard. Thank you very much for your time.

Sincerely,

Russell Okinaka, c/o The Claremont Graduate School